SIXTY-SEVENTH YEAR

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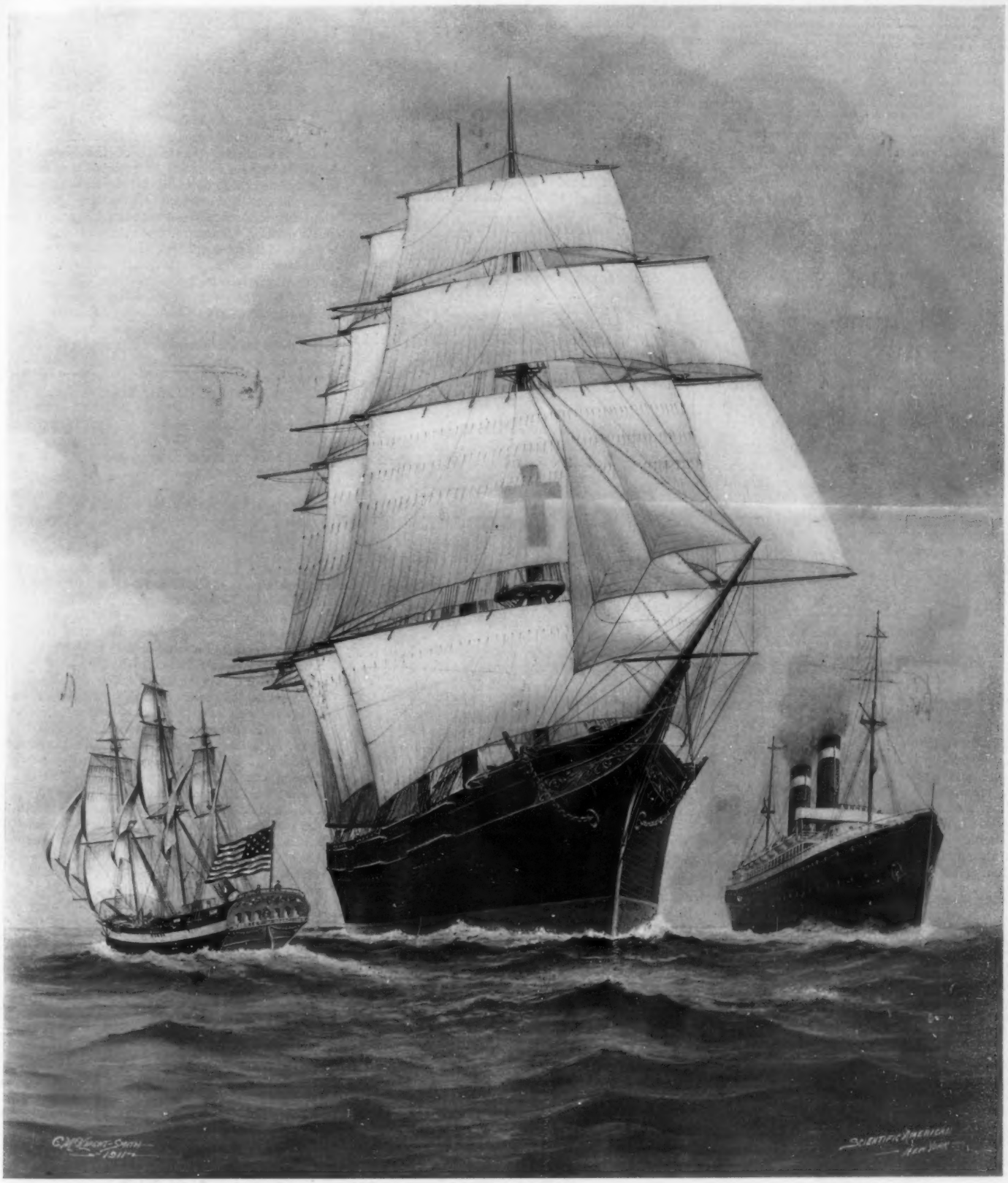

123,893 tons in 1789. 2,496,894 tons in 1861. 718,517 tons in 1910.

**The above are exact drawings of three typical American merchant ships—the "Harriet" of 1789, the "Dreadnought" of 1861, and the "St. Paul" of 1910. Drawn to a scale showing the year's tonnage, they tell impressively the story of the decadence of our merchant marine.**

**RISE AND FALL OF THE AMERICAN MERCHANT MARINE.**—**[See page 426.]**

# SCIENTIFIC AMERICAN

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.


*The purpose of this journal is to record accurately and in simple terms, the world's progress in scientific knowledge and industrial achievement. It seeks to present this information in a form so readable and readily understood, as to set forth and emphasize the inherent charm and fascination of science.*

## One of the Dangers of Flight in a Wind

FREQUENTLY, in describing the sensations of flight, particularly at lofty altitudes, airmen have stated that when they have risen in windy weather to a great altitude it is difficult, and at times impossible, to tell which way the wind is blowing. They say that it is difficult to determine by the sensations, whether the air is still or in motion, and that as far as the progress of the machine through the air is concerned, they can speed up or slow down, reverse its course and perform other maneuvers with the same ease and with the same manipulation of the machine as would occur were the flight being conducted in absolutely still air and near the ground.

There is one important exception to this statement, through ignorance of which it is quite possible that some of the airmen who have fallen from great heights have lost their lives. We refer to the fact that if a machine which is flying against a strong wind be suddenly turned so as to travel with the wind, it is liable to lose its equilibrium beyond any chance of recovery.

To take a concrete case, let us suppose that an aeroplane, capable of flying at a speed of forty miles an hour through the air, is being driven against a steady 40-mile gale, and is therefore holding itself stationary with regard to the earth. The writer witnessed exactly these conditions during the meet last October at Belmont Park, when Hoxsey started against the wind, progressed slowly in his skyward climb, his speed with reference to the earth steadily decreasing as he rose into the higher and more rapidly-moving strata of air, until he reached a 40-mile wind, when, for several minutes, he was poised stationary over the aviation field. In passing, we may mention that Wilbur Wright, who was carefully watching his pupil, drew our attention to the fact that here was a heavier-than-air machine maintaining itself perfectly stationary in mid-air a thousand feet above the ground—something which, a few years ago, would have been laughed at as an utter impossibility.

Now if the average man on the street were asked what would have happened if Hoxsey had made one of those swift turns, in which the machine is reversed in a few seconds, he would probably say that it would have set off in the reverse direction at a speed over the ground of some eighty miles an hour, 40 miles of its speed being due to the wind or the whole moving body of the atmosphere, and the other 40 miles being due to its own speed through that atmosphere.

Also, we very much fear that many of the newcomers among the flyers would make the same assertion.

As a matter of fact, nothing of the kind would happen; for if a swift reversal of the position of the machine were made, so that in a few seconds it were facing in a directly opposite direction, the inertia of the machine would tend to hold it stationary with regard to the earth; and the inertia would have to be gradually overcome, and the machine accelerated, until it reached a speed of 40 miles due to the wind, plus as many miles per hour more as would be necessary to enable its planes to obtain the necessary reaction for support and proper equilibrium.

Indeed, could Hoxsey have immediately reversed his machine, he would have found himself in the position of moving through the air tail first, which would mean that the air pressure would be acting on the upper instead of the lower surfaces of his planes, tending to drive the machine to the ground.

Hence we see how extremely dangerous it would be for an airman who was flying against a strong wind to make a sudden, sharp turn of 180 degrees. The experienced aviator is well aware of this danger; and those of us who witnessed the wonderful flying of Latham in his Antoinette machine, when he circled the field in the same gale of wind to which we referred above, will remember that in moving out of the wind to run down the course with the wind, he turned his machine so slowly as to cover from a third to half a mile before he was straightened out with the wind at his back.

Is it not possible that some of the unexplained disasters of the past twelve months have been due either to ignorance or disregard of the conditions above mentioned?

This subject was discussed by James F. Stephens in an article read at the last meeting of the Western Society of Engineers, on "The Dynamics of the Flying Machine." As the result of his investigation of the dynamics of flight in a wind, the author believes that the fact is demonstrated that in making a turn, the necessity for quick changes in the actual velocity of the machine, required to accommodate its speed to the speed of the wind after the direction of the machine is changed, may be such as to cause the machine to fall for want of sufficient surplus power to meet such variable conditions.

The full text of the paper, which is too lengthy for publication in the SCIENTIFIC AMERICAN, will be found in the next issue of the SUPPLEMENT.

## Secrecy in Modern Industries

IN connection with the recent semi-centennial of the Massachusetts Institute of Technology, Prof. William H. Walker, in making a plea for a more generous publication of results obtained in modern industrial research laboratories, declared that the old alchemy—namely, secrecy—was still in force, and was depriving the world of much knowledge that the discoverers could share without harm to themselves.

There is a heavy moral obligation on the part of large industrial organizations having fully equipped research laboratories, said Prof. Walker, to contribute their share to the advance of the world's knowledge. They have well stocked libraries, and are provided with all the current periodicals; they profit by all the scientific work which has been done and is being done. This is as it should be, and such firms are to be commended for their progressiveness. But is this not a reason why such laboratories should do their part in adding to the sum of available knowledge? There is in every laboratory much work which could be published and yet conserve the interests of the corporation. First, there are the results which may not have proved valuable to the laboratory in which they were obtained, but which would be of immense value to someone else working in an entirely different field. Second, there are those results of value to the laboratory possessing them, but which could be published in an unapplied or "pure" form and which would make an important contribution to science, and at the same time the publication would work no injury to the company or corporation most interested. And finally there are those results of operations and processes, machines and apparatus which, if the truth were known, are possessed by a number of concerns, but are held as valuable secrets by each. Everyone would profit and no one be the loser by so far-sighted and generous a policy. Germany is very justly held up before us as a shining example of marvelous industrial progress and prosperity. A very great deal of the credit for her present position is due to her splendid educational system. But no small factor in her national progress is the helpful attitude which her industrial organizations take toward the publicity of scientific data. The individual does not suffer, while Germany, both from a purely scientific and an industrial standpoint, is rapidly advanced. But too often with us the president and his board of directors are alchemists: they fail to see why, if they pay the salaries of their research men, they should give to the public, or their competitors, any part of their results. They exclaim "What has posterity done for me?" They would have their laboratories remain the secret chambers of the alchemists, and continue to improve their methods of changing baser materials into gold without regard to the obligations which they owe to their fellows.

Although Prof. Walker's claim that "the spirit of alchemy" is still rife in modern industry is largely true, it is but just to state that there are some notable exceptions, as witness the Physical Laboratory of the National Electric Lamp Association, reference to whose work was made in our recent issue dealing with light and heat. Although this association includes the majority of the leading lamp manufacturers, there are several important firms that make no contribution whatever to the expenses of the laboratory. Nevertheless, the valuable results of the costly research work of this institution are published broadcast to the world; the members of the association believing that the advancement of an industrial art by world-wide co-operation results in greater benefit to the individual firms than can possibly be obtained by separate and secret investigations.

## Upper-air Research in Great Britain

TWO countries lead the world to-day in the study of the free atmosphere—aerology—viz., Germany and Great Britain. In Germany, where aerial navigation is a sort of national fetich, under the exalted patronage of the Kaiser, every branch of science relating thereto is being cultivated with enthusiasm. German meteorologists—and Germany has more meteorologists, correctly so called, than any other nation—are becoming practical aeronauts; while German aeronauts are studying the science of the atmosphere. In Great Britain, where there are fewer professional meteorologists, the number of educated people, on the other hand, who take a *dilettante* interest in meteorology is probably even greater than in Germany. The term *dilettante* is not here used in a disparaging sense. The Royal Meteorological Society numbers among its members scores of persons who have made substantial additions to our knowledge of the atmosphere in the leisure intervals of making laws, practising medicine, administering justice, cultivating the soil, and what-not. This circumstance is characteristic of British science generally, but perhaps especially so of British meteorology.

The *Quarterly Journal* of the Royal Meteorological Society for January of this year is almost entirely devoted to aerology. The opening article, by Miss Margaret White, a voluntary observer at the Howard Estate Observatory, Glossop Moor, attached to Manchester University, describes the results of a remarkable series of sounding balloon observations made March 18-19th, 1910. The principal object of these hourly observations was to study the diurnal variation of the height and temperature of the isothermal layer, and this was found to be practically *nil*. The height and temperature of this layer are in close relation to the barometric pressure conditions at the surface, but appear to be quite independent of the time of day. On an average the layer began at an altitude of eleven kilometers above the earth's surface.

W. H. Dines, the veteran English aerologist, describes the campaign of *ballon-sonde* observations carried out at several points in the British Isles during the "international weeks," December 6-11th, 1909, and August 8-13th, 1910. In the second series the average height attained by the balloons was 16.5 kilometers, a little over 10 miles. C. J. P. Cave describes the results of pilot-balloon observations made in Barbados—i. e., within the trade-wind region—during the "international week," December 6-11th, 1909. The balloons were followed by the two-theodolite method, and in one case reached an altitude of 5 kilometers, but without getting above the trade-wind. William Marriot describes the registering balloon ascents made by him during the annual show of the Royal Agricultural Society at Liverpool, June 21-23rd, 1910. Capt. C. H. Ley gives an account of his balloon experiments at Blackpool, England, and in this connection gives many useful suggestions regarding the *technique* of such observations, and some rather novel conclusions as to a subject that is becoming conspicuous in the study of aeronautics, viz., wind structure. Surface winds are well known to be oscillatory in character, i. e., subject to rapid variations of pressure, velocity and direction, altogether analogous to sound waves, but much larger in period, wave-length and amplitude. Like sound waves, these oscillations in the wind appear to give rise to the phenomena of reflection, refraction, diffraction, interference, etc. Capt. Ley endeavors to show the relation between these oscillations and those of atmospheric pressure at the earth's surface, as recorded by the microbarograph. The subject of short period pressure variations is further discussed by Wilhelm Schmidt, of Vienna, who gives the first account in English of his new instrument, the variograph, and the results obtained therewith.

# Wilhelm Ostwald

## A Leader in Modern Philosophy of Science

AMONG the figures which loom large in the splendid company of living German men of science, there is perhaps none whose life work and personality present a greater interest to the general public than Wilhelm Ostwald, whom we may justly call one of the founders of modern physical chemistry.

In drawing an outline sketch of the life of the great chemist and philosopher, we may pass over in a few words his early youth. He was born in 1853 at Riga, on the Baltic coast of Russia. It can not be said that in his boyhood he manifested any very striking indications of his genius; in fact seven years, instead of the usual five, were spent in absolving his regular school courses. He showed, however, a distinct taste for experimental work, especially along the lines of chemistry. In 1872 he was sent to the university at Dorpat. Here also he did not at first give any obvious signs of his coming greatness, though he acquired even at this early stage a reputation among his fellows for the great width of his interests and faculties, a feature which in later life has proved one of his most striking and remarkable characteristics. Presently, however, the young student set to work with a will, and astonished all by passing his examinations in an incredibly short time. From this point on his career advanced steadily and certainly. In 1875 he was appointed assistant at the university, and three years later advanced to a lectureship. While still on the very modest salary attached to such a position, Ostwald in 1880 took upon himself the responsibilities and burdens of wedded life. He has himself drawn a quaint picture of these days of small circumstances and great aspirations in his recent book, "Die Forderung des Tages." It became necessary for him to add to his slender resources by spending two or three hours each day teaching at a boys' school, while carrying on as usual his university duties and laying the foundations for his great Lehrbuch, which to this day is by far the most exhaustive treatise on physical chemistry extant. But promotion soon came. In 1881 Ostwald received a call to a professorship at Riga. An idea of his success as a teacher and investigator during his tenure of this office can be obtained from the figures showing the enrollment of students in his laboratory, and from the fact that during the period 1881-1887 he published no less than thirty original investigations. The number of students in his laboratory increased from 81 in 1881 to 210 in 1886. In the meanwhile the department of chemistry had been enlarged, under the personal direction of Ostwald himself, who had been delegated to visit the various laboratories and institutions of Europe with this object in view. This was his first journey from his native land.

Among the students trained by Ostwald at Riga were a large number who achieved considerable success in after life, but above all others among this number stands out Arrhenius, the originator of the ionic theory. Nernst also, one of the greatest physical chemists of the day, was planning to study under Ostwald at Riga, when the latter was called to Leipzig in 1887, whither Nernst followed him to become his assistant.

This year was a peculiarly eventful one for the young science of physical chemistry. It saw the birth of Arrhenius's theory of electrolytic dissociation and the enunciation by van't Hoff of the laws of osmotic pressure, with the important results in the theory of solution which flow therefrom. In the same year Ostwald founded the *Zeitschrift für physikalische Chemie*, which has remained ever since the chief organ for the publication of original work in physical chemistry.

Ostwald's creative work is imposing even if we consider only its volume. During the sixteen years 1887 to 1903 he published a total of no less than 16,000 pages of original papers, text books, reviews and other matter. Since 1901 he has edited the *Annalen der Naturphilosophie*, a journal founded by him expressly for the purpose of providing an organ for the discussion of topics relating to the philosophy of science. He has also edited, and in part prepared in person for publication, that most valuable series of classical scientific reprints which is known by his name. In his special field of physical chemistry his principal contributions have been devoted mainly to the theory of electrolytic dissociation and the theory of catalysis. The field of application of the former is of course almost boundless, and Ostwald has taken an active part in the development of many of its ramifications. One application, which is of peculiarly fundamental importance to every chemist, is the elucidation of the reactions underlying common methods of inorganic analysis. This last topic Ostwald has treated in collective form in that admirable little book, "The Scientific Foundations of Analytical Chemistry." His work on catalysis Ostwald brought, as it were, to a culmination about the year 1901. While this subject remains to the present day shrouded in much mystery, the view has been greatly cleared by his labors. He first of all established a clear definition of what constitutes a catalyzer, and then drew attention to the laws of catalysis which can be deduced from the second law of thermodynamics—namely, that a catalyzer can not affect the equilibrium ultimately attained in a system in chemical reaction, and, as a corollary to this, that a catalyzer must affect in the same proportion the velocity of both members of a pair of opposing reactions.

PROF. WILHELM OSTWALD

Of late years, especially since his retiring from university teaching, Ostwald has devoted his main efforts to writings of a philosophical and general character. We might date Ostwald's public career as a philosopher from the year 1901, when he delivered at Leipzig University a course of lectures on "Naturphilosophie," a term which perhaps may here be interpreted as meaning a system of philosophy founded upon and dealing with the fundamental facts of natural science. These lectures have since been published both in German and in English. The dominant note that sounds again and again in this work, and indeed in most of Ostwald's writings, is his insistence on the significance of energy and the laws of energy transformations in our interpretation of the physical universe. In so far as living organisms and man himself form part of this universe, and are subject to physical laws, the study of energetics forms a foundation not only for a systematic treatment of the phenomena presented to us by inert matter, but also of those sciences which deal specifically with the properties and behavior of living organisms and communities. Thus one of the more recent of Ostwald's books ("Energetische Grundlagen der Kulturwissenschaft," 1909) is devoted to the exposition of the application of energy considerations to problems of sociology and related portions of science. The supreme position which the energy concept occupies in Ostwald's mind has found expression in the name chosen by him for his country home in Saxony, "Landhaus Energie."

Another cause for which Ostwald has raised his voice in constant and urgent advocacy is the cultivation of a point of view free from hypothetical assumptions. He points out how in the past hypotheses have often been an obstacle rather than an aid to progress, by introducing into our concepts elements foreign to the actual phenomena under consideration. Thus, until quite recently, Ostwald refused to make use of the mechanical theory of heat, according to which this phenomenon is to be construed as "a mode of motion," the rapid oscillation of the molecules of matter. Neither the molecules nor their motion were directly accessible to experimental observation; they were purely hypothetical, and their postulation, in Ostwald's view, was not only unnecessary, but undesirable. This view was maintained in the face of the brilliant work of Bernouilli, Waterston, Clausius, Maxwell, Boltzmann and others, which, by a triumphal feat of human ingenuity, furnished actual numerical estimates of molecular dimensions. To properly realize what this means, we must recall that for example the diameter of a molecule (supposed spherical) is thus found to be of the order of 0.00000003 centimeter, or 0.00000001 inch, while the smallest object of which a microscope can under ordinary circumstances form a distinct image is of the order of 0.00001 inch, and this limit is due, not to imperfections of the microscope, but to the inherent properties of light, so that it can never be passed by the ordinary method of using the microscope.

This impresses us at once both with the brilliancy of the intellectual achievement of the workers in the kinetic theory, which enabled them by various methods to obtain very fairly concordant estimates of the dimensions of such excessively minute objects, and also with the seeming justification of Ostwald's objection, that such hypothetical estimates were worthless, since there was no means of confirming their truth by experiment. But the unexpected has happened. Recent developments in ultra-microscopy have furnished the most brilliant vindication of the point of view of the kinetic theory. The powers of the ultra-microscope stop short, it is true, of the average molecular dimensions of the simpler bodies. But Zsigmondy has succeeded in obtaining direct evidence, by means of his ultra-microscope, of particles of gold whose diameter is only about four times that calculated for a molecule by the kinetic theory. Moreover, the study of very small particles in suspension, and of the Brownian movement which they display, and other recent developments, especially in the field of electricity, have given the most striking confirmations of the conclusions reached by the methods of the kinetic theory.

In the face of this turn of events Ostwald himself has now withdrawn his opposition to the kinetic theory, and has publicly gone over to the side of its adherents. The question might now be asked: Of what value, then, are the somewhat complicated arguments which were brought forward by Wald and strongly indorsed by Ostwald (among other occasions in his Faraday lecture, 1904), to show that the laws of chemical combination were explicable independently of the atomic theory? The answer to this, in brief, is that the clearing up of the fundamental concepts and methods of scientific thought is quite as important a matter as the addition of isolated facts to our store of knowledge.

The extraordinary breadth of Ostwald's interests and productions makes it hard to judge at the present time the full value of his work, for his influence must in time become felt in the most varied fields of knowledge. Little hesitation need, however, be felt in prophesying that future workers in science and philosophy will trace back many avenues of thought, many paths of progress, to the influence of Ostwald's writing and teaching, and many a growth that will mature in after days will be found to have had its germ in some point or principle foreshadowed in his works.

# The Voisin "Canard" Biplane

## How Gabriel Voisin Invented His Biplane Christened the "Duck"

THE photographs reproduced on this page show a new type of biplane brought out of late by the Voisin brothers. This machine has a long body projecting in front, and, when in flight, it has the same appearance that a Blériot monoplane would have if flying backward. The horizontal rudder is placed at the extreme front end of the long tapering body, and it occupies the same position that the tail occupies in a monoplane. The motor is at the rear end of the body (corresponding to the front end of a monoplane), and the two planes are attached to the body and mounted over a pair of wheels at this end. The ends of the planes are connected by vertical partitions, such as were used in the Voisin machine in its early stage of development. There is a second pair of wheels placed below the body at the front, and the vertical rudder is mounted above the body at this end also. Beside the body, just above the wheels, there is on each side an inclined fin that looks for all the world like the mud-guard on an automobile.

The spread of this new biplane is about 36 feet, and the planes are 6 feet 7 inches in width. The planes are spaced 5 feet apart. Their total supporting surface is 474 square feet. The planes are set at a slight dihedral angle. The dimensions of the horizontal rudder at the front end of the body are 12 feet by 3 feet 7 inches. It contains about 32 square feet of supporting surface, while the vertical rudder has 6½ square feet. Below the planes at each end there are curved skids in case the machine tips when near the ground. The motor used is a 50 horse-power Rossel-Peugeot revolving-cylinder motor, which resembles the Gnome.

The first flights of the "Canard," or "Duck," as it is when translated, were made early in February at Issy-les-Moulineaux by Collieux. On February 3rd he carried two passengers in a strong wind of 25 miles an hour, and the machine flew very steadily and gave an excellent performance. On February 5th he demonstrated its turning abilities before a number of military men, and again, the following day, he flew with passengers. The pilot's position is 6 or 8 feet in advance of the main planes, and when a passenger is carried he is seated back of and above the pilot.

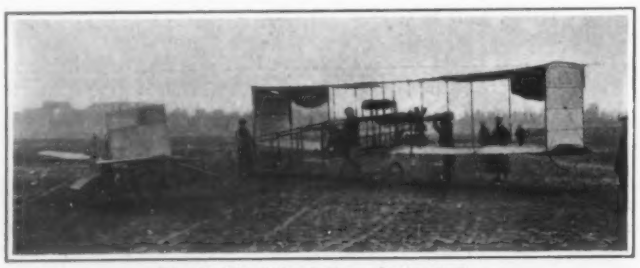
Regarding the conception of this machine and its advantages, M. Voisin says, in *La France Automobile et Aérienne*, it was conceived as the result of his various experiments. In 1904 he was experimenting and building a machine for M. Archdeacon. The main surfaces consisted of two superposed planes, 10 meters by 2 meters in size, and having placed at 3½ meters in front, a horizontal rudder. The "Canard" was practically the same machine with the body lengthened 5 meters in order to bring the horizontal rudder that much farther forward of the planes.

The above experimental glider, which was tested at Berck-sur-Mer when Voisin was experimenting with Captain Ferber, was instrumental in giving the former the European record of duration in a glider, which was 6 4-5 seconds. The following year he added a rear cell or biplane tail and experimented in towing the same above the Seine, the results being so satisfactory that Delagrange and Farman fitted motors to similar machines and were soon making successful flights.

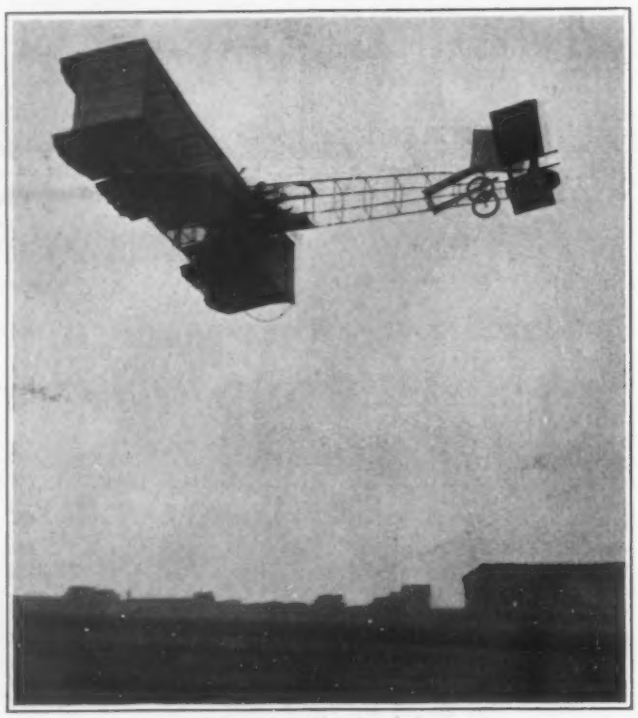
This original Voisin machine, which was changed in every conceivable manner by different experimenters, and which achieved its great success in the hands of Henri Farman, M. Gabriel Voisin believes reached its highest point of development last year. In his opinion, however, it is a dangerous machine in landing, and is difficult to maneuver on the ground, being cumbersome and not at all strong if it is badly constructed. Finally, he does not believe it capable of further improvement.

Santos-Dumont, in 1906, had his first success with a machine similar to the "Canard" in many respects. Blériot imitated Santos-Dumont, and also tried a monoplane with the elevator in front. The bad location of the centers of gravity and pressure and a sharp dihedral angle obliged Santos-Dumont to give up the type of aeroplane which he used successfully at first, and to develop the "Demoiselle" with which he flew later. Last year M. Fabre, at Marseilles, made successful flights with a monoplane similar to the "Canard," this machine being the first aeroplane to rise successfully from the surface of the water and make a flight. Only last February did Glenn Curtiss accomplish this same feat with a biplane. As late as last July M. Voisin was shown by M. Lacoin a model of an aeroplane similar to the "Canard," and having the rudder in front and two propellers back of the main planes. This little machine surprised Voisin greatly by its truly extraordinary stability. Although he did not have the dimensions of the model, he finally constructed a machine along these lines, and the tests have shown it to work remarkably well. He believes that the great need of aviation is an aeroplane that is sure and comfortable, and that has its seat near the ground, while it is easy to maneuver on *terra firma* and is so designed as to do away with accidents due to the propeller. It was only after a great deal of study and figuring that he fulfilled these conditions, as he believes, in the "Canard." He does not know what form the aeroplane of the future will have, but he believes that, like the "Canard," it will resemble very closely an arrow.

He expects that this new form will be widely copied as soon as its good qualities have been more thoroughly demonstrated, but he hopes that the constructors will take care to make strong and reliable machines, so that his invention will not be given a bad start, and that its excellent qualities will be brought out.



The Voisin "Duck" ready to start.



The "Duck" in Flight.

THE VOISIN "CANARD" BIPLANE

### The Automobile Fire Engine

IN the passing of the steam fire engine in favor of the high pressure system of independent water mains and hydrants, now clearly established as not only the best practice but an absolute necessity for all large cities, there are many mechanical questions to be considered that lend increased importance to these familiar portable pumping machines clanging through our city streets. Notwithstanding the triumph of high pressure systems and central station pumps, the day is far distant when they will be employed exclusively, and for many years the majority of American cities will be compelled to rely on fire engines for protection. The gradual elimination of horses in favor of motor apparatus, so extensively inaugurated, means not only a long step forward toward efficiency, as secured in increased speed of travel and the ability to transport heavier and more powerful machines, but also the development of new types of apparatus that are radically different. These are economical and effective substitutes for the horse-drawn fire engine, and at this time it is of interest to consider the various types.

The first proposition is to eliminate the running and draft gear of the front wheels of the fire engine and substitute a four-wheel motor chassis, thus making a six-wheel piece of apparatus, as is done in the tractor for water towers and commercial heavy vehicles. Such a chassis may have either powerful gas engines or a combined gas-electric driving mechanism with motors at each of the four wheels. This means simply adding the tractor to any existing fire engine without the slightest alteration, and affords complete interchangeability. This device has worked successfully with water towers, extension ladder trucks and commercial vehicles, and manufacturers are desirous of applying it to the heaviest steam fire engines.

Then there is the plan successfully realized in the new engine for the New York Fire Department, recently described in the SCIENTIFIC AMERICAN, and in one being rebuilt for the Birmingham, Ala., Fire Department, where the frame is lengthened and a powerful motor placed in front of the engine proper, but geared by chains to the rear wheels. This arrangement gives a complete and compact four-wheel piece of apparatus capable of high speed with hill climbing power. In the second size engines to which it has been applied it has worked with complete success. Both of these types of machines require no change in the pumping machinery and boilers, which present all the advantages and disadvantages of the steam engine when compared with the internal combustion motor. With both combined in one machine this is quite apparent. There is the increased weight of boiler and engine with fuel and water, the appreciable amount of time required to get up steam, and the necessity of maintaining a boiler at the fire house. Furthermore, there is the rapid deterioration of such a machine in service and the difficulty of securing engineers adequately trained and capable of maintaining the fire engine and operating it at highest efficiency. In other words, should not the steam engine follow the horses, and gas engines be used with the pumps as well as for propulsion?

The answer to this is found in a third type of fire engine, where the engine can be disconnected from the driving gear and linked up with the pumps. This is now done for small and medium-sized machines that even now have a wide sphere of usefulness, especially in the suburbs and for rural districts, and for first alarm calls in small cities or residence districts.

Both rotary and reciprocating pumps are used with such machines, and they are receiving thorough tests in actual practice and improvements at the hands of manufacturers. As yet no maker of gasoline engines has announced his ability to put out the equivalent of an extra first size engine that can travel to a fire at a speed of thirty miles an hour. If this can be done and the record of the steam fire engine for reliability and power be equaled, then the motor fire engine will in a few years supplant all other types. Otherwise steam apparatus will long be found in service.

### Reducing Zinc Ore With Petroleum

IN certain economic conditions coal is too costly for use in reducing zinc ores. Hughes and Hale have found that these ores can be reduced satisfactorily with crude petroleum, after preliminary wasting. The great reducing power of petroleum is increased by the fact that both the zinc oxide and the reducing agent are in the gaseous state.

# A Painting in Glass on a Canvas of Concrete

## Mosaic Curtain of the Mexican National Theater

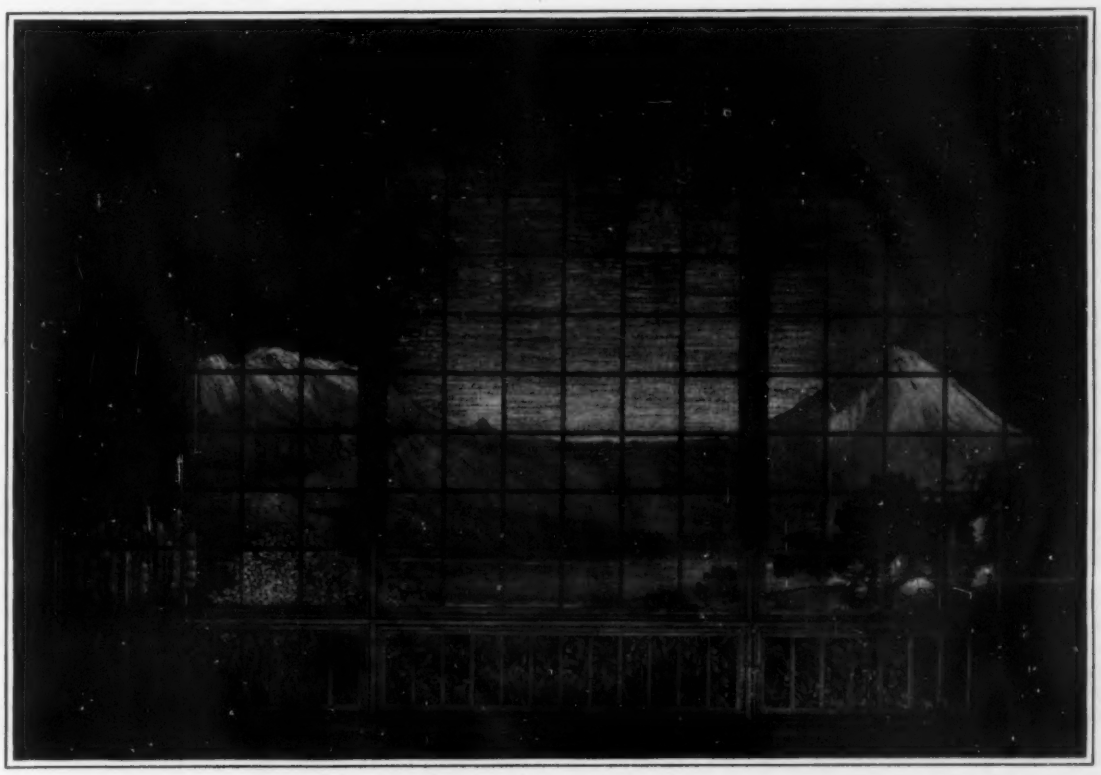
ONE is so accustomed to look upon Europe as the center of all art that he does not even stop to ask whether "any good thing" can come out of the United States. Hence, it is likely to prove a distinct surprise to many that the architect of the beautiful National Theater of Mexico, after hunting the world over for a suitable material to build the curtain of the theater, and an artist to depict upon it an appropriate scene, ended his quest successfully in New York city.

The subject chosen was a view of the twin mountains Popocatepetl and Ixtaccihuatl that rise far above the snow line 45 miles southeast of the city of Mexico. There is a legend connected with these mountains that has been handed down from the time of the Aztecs, which runs as follows: In the days of the Montezumas there was a powerful monarch who had a beautiful daughter named Ixtaccihuatl. Her lover Popo was required by the king to prove his worth by winning a certain number of battles before he could attain the hand of the princess. In the meantime he was not even to see his love. But unable to wait, the lovers met in secret, and when this was discovered the king, in his wrath, turned them both into mountains. The cold outstretched form of the princess may be clearly made out on the snow-topped mountain Ixtaccihuatl, and it is said of Popo that although he was turned into a mountain, the fires of his love could not be quenched, as evidenced by the smoke that pours from the lofty peak of Popocatepetl. It was this scene that the architect Adamo Boari wished to reproduce because it is typically Mexican and is one of great beauty quite aside from the legend connected with it. The curtain, however, was required to be fireproof; and while it was at first thought that the scene could be painted, it was decided that this would hardly do, for the reason that even a small fire would crack the paint and cause it to blister and peel. It was next decided to reproduce the scene in glass. The famous Venetian and Bohemian glass was investigated, but the desired result could not be obtained. Finally it was suggested that the curtain be made in mosaic of Tiffany "Lustre" glass, and this proved to be just the material required. The glass is possessed of a billiant opalescence due to a process discovered by Mr. Louis C. Tiffany. In the composition of the glass metals such as iron, tin, antimony and the like are used. The metals are then brought to the surface by reducing the glass in a flame, and the opalescent effect is further heightened by subjecting the glass to metallic fumes. The variations of colors produced by casting different shades of light upon the glass are exceedingly beautiful, and well suited to reproduce the play of light upon the famous mountains under the glow of the setting sun.

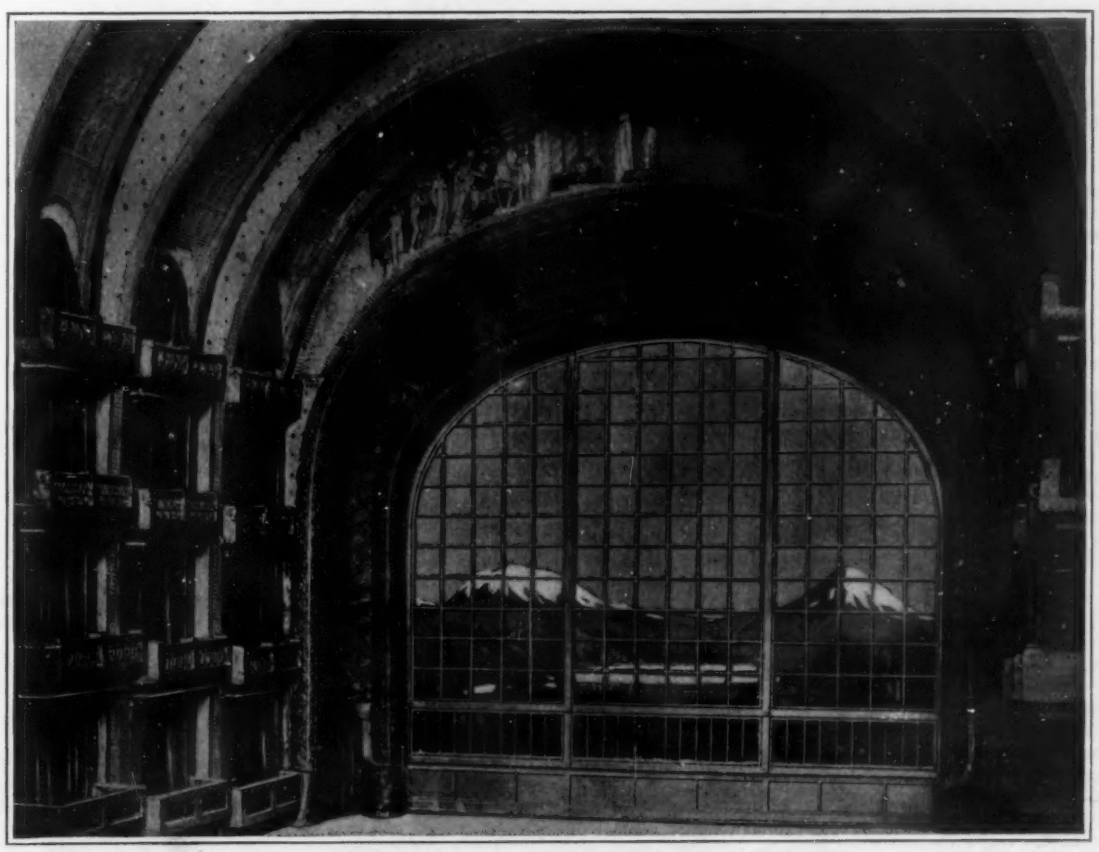
In order to make a true picture of the scene an artist was sent to Mexico to paint the requisite details. The task of reproducing the paintings in glass was no small one. Twenty mosaic workers have been employed for over fifteen months at this work under the direct supervision of Mr. Tiffany. Bits of glass a fraction of an inch in area are inlaid in a backing of fireproof cement an inch and one-half thick, and this in turn is supported upon a steel frame. There are nearly a million separate pieces of glass, covering an area of 2,500 square feet. The entire weight of the curtain is twenty-seven tons and yet when in place it will be raised or lowered in but seven seconds by hydraulic mechanism. It would be impossible to make the curtain in a single sheet of the dimensions required and transport it safely to the city of Mexico. For this reason it was decided to divide it up into sections, as shown in the accompanying engraving. Each of the small sections is three feet square. They are placed in a bronze frame which conceals the joints and gives one the impression that he is viewing the scene through the panes of a large window.

While the brighter parts of the scene are reproduced in "Lustre" glass, and this same type of glass is used to a large extent throughout the scene, the snow on the crests of the mountains is reproduced in dense opaque glass, so that it always appears snow white with only a slight tinge as different colored lights are cast upon it. One of the drawbacks that an artist who paints on canvas has to contend with is the fact that his pigments do not reflect sufficient light to portray accurately a

(Continued on page 435.)



A twenty-seven-ton theater curtain of glass mosaic, showing the lover mountains Popocatepetl and Ixtaccihuatl.



A model showing the interior of the theater.

MOSAIC CURTAIN OF THE MEXICAN NATIONAL THEATER

# American Merchant Marine

## An Expert Analysis of an Important Economic Problem

By Francis T. Bowles

*THE writer of the following article needs no introduction to the readers of the* SCIENTIFIC AMERICAN. *He will be recognized as formerly, for several years, the Chief Constructor of the United States Navy. Recently, in the face of close competition from the leading yards of Great Britain and the Continent, he was successful in securing to America a* $22,000,000 *contract for two Argentine battleships. His article is a lucid and highly authoritative contribution to a discussion of supreme national importance.*—EDITOR.

It has been officially estimated that citizens of the United States pay for the transportation of their over-sea commerce, including freight, passenger fares and mails, the sum of $229,100,000 annually. This estimate is on a low basis of freight, and it is believed that the actual amount paid is nearer $300,000,000. Practically the whole of this business is in the hands of foreigners, and this expenditure is paid to them and must be considered as an item against the United States in the balance of trade, on account of which we must export products of the United States in payment.

### Sound Economic Reasons for Protection.

There is, therefore, entirely apart from the military value of sea power, a substantial economic reason why the United States should become a carrying nation. The experience of sixty years of free trade in ocean transportation has conclusively shown that it is not profitable to American capital under present conditions and requires protection or some form of government aid or subsidy. A comprehensive system of such protection, which will admit of development of either cargo or mail steamers as the necessities of trade require, should include:

First. Mail compensation to steamers such as is provided and now authorized under the ocean mail act of 1891.

Second. Remission of the head tax of $4 on immigrants arriving in American vessels, which would be a substantial advantage to American mail steamers.

Third. A discriminating duty applicable to vessels of all types, but especially adapted to the development of cargo vessels under individual ownership. A method of applying a discriminating duty which would not disturb the free list, and would not appreciably affect the market of value of imported merchandise or materials would be to enact a law providing that on all goods imported in American vessels on which the *ad valorem* duty exceeds 41 per cent, there would be a reduction of 5 per cent, and on all goods on which the *ad valorem* is 41 per cent or less, or which are non-dutiable, the importer should receive an importer's certificate available only for the payment of duties at the Custom House and equal in value to 2.05 per cent of the value of the goods so imported.

The average rate of duty under the present tariff is understood to be 41 per cent *ad valorem*, and 2.05 is 5 per cent of 41. These figures may not be exact, but they are intended to be sufficient to create a demand for American cargo boats in the foreign trade, by enabling the shipper to pay such vessels a higher rate of freight on homeward voyages, and enough higher to overcome the handicap of higher cost of vessels and operation under the American flag. They are probably sufficient for the purpose on all except some low-priced bulky cargoes.

On outward voyages the American would be obliged to take the competitive rate.

If, then, all our imports were carried in American vessels and half the goods were free or non-dutiable, this proposed law would be equivalent to a 10 per cent reduction in the tariff.

The total value of imports in the United States for the year ending July, 1910, was $1,562,000,000. If, under the operation of the laws proposed above, citizens of the United States should acquire the carrying of, say, $500,000,000 worth, or about one-third of this amount, in American vessels, it would probably be necessary to acquire under the American flag about 500 additional vessels, of various types, which might have the average tonnage of the foreign steam vessels entering our Atlantic ports, or about 3,000 gross tons. It would probably take ten years to build these vessels at a cost of about $200,000,000 if built in the United States. They would employ on board about 40,000 men, and would be earning from $80,000,000 to $100,000,000 gross annually. The total cost for the annual charge on the United States at that time under the laws proposed would be approximately $10,000,000 a year, and during the ten years in which this business was being acquired might have amounted to $50,000,000.

This, in a broad way, is the problem which we are considering in the acquisition of a merchant marine in the foreign trade.

### The Free-ship Fallacy.

It has been proposed to build up the merchant marine in the foreign trade in the hands of American citizens by permitting them to buy ships built by foreigners and place them under the American flag, and that is a question which should be faced and discussed on its merits. At present the law forbids the use of foreign-built vessels in the coasting trade, and American citizens are not permitted to register foreign-built vessels for the foreign trade, though they may own and operate them under a foreign flag. Treaties of commerce and navigation and United States laws provide that there shall be no discriminating taxes or dues in our ports on foreign vessels other than those imposed on American vessels in the same trade. Therefore, free trade exists in ocean transportation. It is now proposed as a means of developing American shipping to extend free trade to the purchase of vessels.

We know from sixty years experience the result of free trade in ocean transportation, and that since it was established our shipping in the foreign trade has continued to diminish until it is now insignificant in amount, carrying only 8 per cent of our imports and exports. This should lead us to consider with some considerable reluctance the extension of a policy which has already produced such results.

Merchant vessels can be built in England and Germany for prices 40 to 50 per cent less than United States prices, because the cost of labor, materials and manufactured articles going to make up the cost of a United States vessel is higher. The cost of the average merchant vessel to the shipbuilder is nearly equally divided between labor and materials; the materials including a large proportion of manufactured articles, pumps, machinery, electrical and plumbing supplies, all of which are protected by the tariff. The shipbuilder's labor costs are 70 to 100 per cent greater than the foreigners. The material costs are 15 to 20 per cent greater. The tariff permits importation free of duty of shipbuilding materials for vessels in the foreign trade and limits such vessels to not more than two months' service annually in the coastwise trade. This privilege has been used by the shipbuilders and American owners in very few instances.

### Why We can Build Battleships Cheaper Than Abroad.

Under present conditions of the amount of shipbuilding available it cannot be anticipated that this relation of foreign to local cost will be materially changed in the next ten years. These facts are not affected by the ability of the United States to compete with foreigners in the building of battleships, that being so in spite of the fact that the American shipbuilder's costs on the hull of the vessel are greater than his foreign competitor; but this handicap is overcome by the ability of the American armor and gun manufacturers, who supply half of the cost of the vessel, but undersell their foreign competitors. It is well known that the cost of operation of steam vessels is lower under foreign flags than under the American, and testimony given before the Merchant Marine Commission was to the effect that foreign costs averaged 30 per cent less than American costs, principally due to less cost of wages. There have been some notable examples of transfer of vessels in the foreign trade from American to foreign flags to take advantage of these conditions.

### Foreign-built Ships Would Cost More to Operate.

It is certain that foreign-built vessels cannot be as profitably operated under the American as under foreign flags in the general foreign trade. There are probably some special trades operating to Central America, the West Indies or British North America, in which the conditions of operation would be necessarily local, and in which the lower first cost of a foreign vessel would be an advantage. If foreign vessels were so employed under the American flag it would be simply a special privilege; it would not create new business nor reduce the cost of transportation; it would not create an American merchant marine.

It is probable that free trade enthusiasts will not be patient enough to verify these statements, and will favor the treatment of the merchant marine to a prescription of blood-letting by means of a free-ship bill, to see how it works. A free-ship bill would give special privilege to a few short routes. It would give an apparent increase in tonnage in the foreign trade, and would ultimately result in the admission of foreign built vessels to the coast trade and thereby in the inevitable destruction of American shipbuilding and consequently of any real American shipping. This industry, which is now menaced by free trade, has produced the shipping of the United States, which on June 30th, 1910, including all kinds of documented shipping, comprised 25,740 vessels of 7,508,082 tons.

### Merchant Marine as Naval Auxiliary.

If we suppose for a moment that the military advantages of sea power made it necessary for the United States to have in the foreign trade a merchant marine of vessels adequate for carrying coal, provisions, troops and to serve as fleet auxiliaries, and that the question was simply how to produce that merchant marine as economically and as quickly as possible without regard to its effect upon American citizens engaged in shipbuilding and its allied occupations, undoubtedly the quickest and cheapest way would be to admit foreign-built vessels to American register and to give them sufficient of the advantages of mail compensation and discriminating taxes to overcome the disadvantage of operation under the American flag. By this means, in acquiring the 500 vessels necessary to carry one-third of our imports under the American flag, we should save possibly $75,000,000 of the $200,000,000 necessary to produce those ships in American shipyards and we could reduce by nearly one-half the aid which we would be obliged to give to American-built vessels. By this means we would have answered the military necessity for a fleet of auxiliaries at the least possible expense. But we would not have placed the merchant marine on a sound and continuing basis for development. We would not have accomplished the economic advantage of an actual American merchant marine, nor would we have given our citizens the opportunity to develop and organize the business of shipbuilding and ship owning. On the other hand, we would have simply hired foreigners to perform this work in a slightly more expensive manner than they are performing it now, for a military purpose which cannot commend itself as a necessity.

### Why Kill Our Shipbuilding by Free Ships?

A ship is probably the most elaborate and complex product, and includes within itself the application of the best skill in more mechanical trades than any other single construction which the world uses. Therefore, it is difficult to understand why the art of shipbuilding should be selected for extinction by the application of free trade, when it is probably intended to permit other manufacturing industries to continue to live. It might be fair to treat ships on the same tariff theory on which we are considering other manufactures, namely, to apply an import duty based upon the difference in cost and regulate it from time to time as required. At the present time it would probably be necessary to establish a duty of about $40 a gross ton on bulk cargo steamers and $60 a gross ton on combined freight and passenger steamers. The application of duty per ton, which is a recognized and established system of measurement throughout the world, would prevent the dumping in this country of second-hand, worn-out vessels, and it is desirable from that point of view.

The experience of foreign governments with a free-ship policy is instructive. Great Britain is often cited as a bright and shining example. But Great Britain did not adopt free ships until 1849, or, in effect, until 1854, when iron shipbuilding, thanks to large mail subsidies, had become so strongly established in England and Scotland that these British yards could defy the world. Neither then or at any subsequent time did British merchants buy largely of foreign-built ships, except in the four years of our civil war, when the Anglo-Confederate privateers drove 750,000 tons of American sail craft under foreign colors for protection.

France, in 1881, after a long trial of free ships, found herself with a smaller tonnage—914,000—than

it had in 1870—1,072,000 tons. Meanwhile French shipbuilding had been so nearly destroyed that it was difficult to maintain a decent war fleet. This experience drove France to a subsidy policy, under which its merchant shipping has increased from 914,000 to 1,900,000 tons. Germany, while relying on free ships alone, increased its tonnage only from 1,098,000 in 1873 to 1,243,000 in 1881. Ships were bought in England long enough for German engineers to learn the art by access to the best plants, and then, under the leadership of Bismarck, a vigorous policy of imperial protectionism was embarked on in the form of mail subventions and other aids to native shipbuilding, with the result that German tonnage grew swiftly from 1,243,000 to 4,307,000 now. Norway is often pictured as another bright example of free ships; but Norwegian tonnage since 1881 has not increased so rapidly as French tonnage, and Norway of late years has been applying a subsidy policy of its own. Japan tried nothing but free ships until 1894, with the result that it had then only 200,000 tons of merchant shipping. The war with China forced Japan to turn to national aid, and Japanese ships have grown more swiftly than those of any other nation in the world, or from 200,000 tons to 1,544,000. Japan gives bounties to native shipyards and subventions to regular lines.

**Free Ships Should be Offset by Bounties to Native Ships.**

To grant free ships without any direct aid to home shipyards is a policy abandoned now by all maritime governments. Those nations that allow their people to buy ships abroad either impose a tax on those ships when naturalized, or forbid the subsidizing of those ships, or grant bounties to ships of native construction. These other governments realize that no nation in the world's history has ever succeeded as an owner of ships that was not also a builder of ships, and that to depend upon ships built abroad is to strengthen the resources of the competitor that builds them and to postpone the day of successful competition at home.

It has been the endeavor herein to make clear that free ships will operate undoubtedly to the disadvantage of American labor and also will retard the acquisition of actual sea power by the United States. The development of American shipping and shipbuilding can only result from the same kind of encouragement that has been given by the protective tariff to other manufactures.

American shipbuilders on the coast can expect to reduce their costs of construction only by the organization of their business which is possible by continuous work on vessels of similar types. This has been the experience on the Great Lakes, where large numbers of vessels of similar construction have been built for bulk cargoes at a low cost after the business had become organized by experience.

The coast shipbuilders have insufficient work for their plants and work so various in character and variable in quantity that their organization is unduly expensive and their labor inefficient.

## The Current Supplement

ALMOST exactly three centuries have passed since Kepler discovered the laws of planetary motion. The simple and ingenious empirical process that led Kepler inevitably to the discovery of the true form of planetary orbits is not generally known. This process is described very clearly in the opening article of the current SUPPLEMENT, No. 1843. Madame Curie describes in detail how pure radium chloride is separated from the barium chloride with which it is associated. The French Senate recently passed a law which was approved by the Chamber of Deputies fourteen years ago, and which will make the legal standard time in France 9 minutes and 21 seconds slower than Paris mean solar time. The reasons for selecting this interval of 9 minutes and 21 seconds, the reservations by which a complete and formal adoption of the meridian of Greenwich has been evaded, and the advantages and disadvantages obtained, are admirably discussed in the current SUPPLEMENT under the title, "International Standard Time." The fourth instalment of Mr. Walter V. Turner's splendid paper on "The Air-Brake as Related to Progress in Locomotion" is presented. A life-saving service for the rescue of miners in time of disaster is the first important step taken by the United States Bureau of Mines in an effort to reduce the appalling loss of life in American coal mines. The service is described in an excellently illustrated article. The distinguished German biologist, August Weismann, writes on Charles Darwin. Mr. A. D. Morehouse, Office Engineer, Drainage Investigations, contributes an instructive paper on "The Reclamation of the Southern Louisiana Wet Prairie Lands." Under the title, "Eugenics and Genetics," Mr. G. Clarke Nuttall presents a thoughtful article on some old problems called by some new names.

# Correspondence

*WITH particular pleasure the Editor inserts the following letter. It is timely, as the expression of an opinion opposite to some of those embodied in Mr. Bowles's able article; moreover, in his concluding sentences, Mr. Noble sounds the keynote of these correspondence columns. We believe that they should be, and are, a "most effective method of education." The Editor makes no claim for infallibility, either in his selection of material or in those pen-chats which are known as the editorial columns. He gives you his ideas, and asks for yours. If you have opinions on current topics which you think will be valuable to the public, send them in. Don't be too harsh a judge of your own literary qualifications. Many an acceptable writer has discovered himself as the result of a letter, written with much diffidence to the Editor, that was published with hearty approval.*

*So let it be understood that, if you have something worth while, which you would like to say to the hundreds of thousands who read the* SCIENTIFIC AMERICAN, *you are invited to send it in for our sympathetically critical reading.*—EDITOR.

## The Merchant Marine and Preferential Duties

To the Editor of the SCIENTIFIC AMERICAN:

As I have already occupied some of your valuable space on the subject of our merchant marine, I do not feel entitled to any more in response to your invitation to discuss the subject. I should, however, be pleased to know that you have considered the following:

I do not feel at all certain that preferential duties will work as well to-day as they did prior to 1810, nor am I convinced that the preferential duties were the real cause of our prosperous ocean carrying trade at that time. It seems to me that it was due vastly more to the fact that European wars were keeping European merchant vessels from competing with us, and perhaps even more to the fact that there was then no high protective tariff to make the cost of labor much greater here than in Europe. As a matter of fact, did not our shipping industry continue to prosper (in the main) until the passage of the Morrill Act in 1861? And is not its decline almost exactly proportional to our prosperity in the inland protected industries?

The objection to preferential duties, it seems to me, lies in the fact that they will not apply themselves directly to the object sought, and to that alone; also that they will tend in many instances to build up our shipping industry in the least desirable directions and fail to build it up in the most desirable directions. Thus, a five per cent remission of duties will encourage American vessels in the carrying of those commodities only on which we have a tariff, and probably on those only on which our import duties amount to the most *per ton*. For it is not to be presumed that foreign nations like Great Britain are going to let us capture all or the bulk of their carrying trade even with us. If they let us regain our share (one-half) we should be well satisfied. But the trouble with preferential duties will be that they will encourage the carrying in American bottoms of practically all the imports from just such countries as England and Germany, because the remission of duty per ton on such high-class products as come from these countries will be most tempting to American vessels, while it will have practically no effect on importations from such countries as Canada and South America. Hence, instead of finding a market for our manufactured products, which is what we want, we shall be providing a market for foreign manufacturers, just what we do not want.

Likewise, to those countries from which we would import more high-class commodities, viz., European countries, we should also export low-class commodities like cotton, wheat, and corn. For in order to get the full benefit of the remission of duty on the incoming traffic in high-class commodities from Europe, our American vessels would be compelled to go to those countries laden with such commodities as those countries will purchase, which will be the low-class commodities named, and the competition for the carrying of these commodities would have its effect in increasing their export. We would then be in the foolish position of having one law (Canadian reciprocity) to encourage the importation of these commodities and another to encourage their exportation!

Again, the European countries from whom we would thus take the carrying trade (if they took no retaliatory measures) would be compelled to seek South American trade for their vessels, and in so doing would even more rapidly than now develop valuable commercial relations with those countries, the very countries about which we ought to be the most solicitous.

But we may depend upon it that European countries will never stand idly by and allow us to manipulate things in this way. They will retaliate, with the effect that our remission of duties will represent so much money dumped into the ocean, with no permanent effect in building up our own merchant marine.

Instead of intruding our vessels into European ports where they are not wanted and for a trade that we do not want, let us devise some means for securing berths for them in South American ports, where we have a natural right and will have a hearty welcome, and let us encourage the trade that we do want, and must make some special effort to secure, and thus increase our influence where it is alike most needed and most profitable to us. Why build the Panama Canal, and then pass laws that will practically forbid American vessels the use of it?

Finally, it is a humiliating comment on American intelligence that we can be induced to pay indirectly for a thing that we will not pay for directly. What we want is to receive considerable education in the matter of our duty as a great world power, whose liberty-fostering institutions are destined to leaven the whole lump. I congratulate you upon having adopted one of the most effective methods of education, that of taking the people into your confidence and inducing them to study this subject and to express themselves. I certainly hope that you will be flooded with as many and as opposing views as this country can produce and you can find room to print.

Hettinger, N. D. N. J. NOBLE.

## Stability of Cofferdam Around the "Maine"

To the Editor of the SCIENTIFIC AMERICAN:

I noticed in your paper a publication of the general outline of the cofferdam which it was proposed by the United States Government to build around the wreck of the battleship "Maine," and it seems to me that there are two points of possible failure of a structure of this kind which have not been discussed.

One is the fact that each of the single structures is an aggregation and not a unit, and that failure is liable owing to the lack of frictional resistance between each of the individual piles, and it seems that failure is possible by the structure collapsing like a line of blocks, each pile sliding on the other.

Second: It seems that if sufficient frictional resistance between the piles is provided by riveting straps across the piles, joining them together, there is danger of collapse of the inside toe of the structure, because of the lack of longitudinal support of the individual piles at that point. For illustration: If we take an ordinary tin can, such as tomatoes or other vegetables are preserved in, and cut the head out of one end of it, then place this can on the floor in a vertical position, if weight is placed upon the can and the same is slightly tilted, the portion in contact with the floor will collapse.

This seems to me to be the position of this cofferdam, particularly in view of the filling which is being used in the cylinders, which filling consists of soft mud, which is pumped into the cylinders and which must remain for some time in a semi-fluid state, thus offering nothing in the way of resistance to longitudinal pressure. This condition might to a certain extent be improved if the filling within the cylinders was made of a mixture of clay and fine stone, which for some reason seems to form a very solid mass.

In a case in my own experience, where clay was being used to stop a leak in a cofferdam where timber was placed against an inclined ledge, the clay failed utterly until a certain amount of finely broken stone was dumped in, then the mass became very firm and all leaks were permanently stopped; thus it seems to me that a mixture of this kind would increase the stability of these cylinders. Certainly if the cylinders with their filling were monolithic and the foundations under them firm, there would be no question as to their efficiency; but the further they depart from this condition the more liable they are to failure, and therefore it seems to me that every reasonable effort should be made to approach this condition as nearly as possible.

New York, N. Y. E. C. MOORE, C. E.

## How Deserts are Formed

THERE is a popular idea that deserts like the Sahara are the bottoms of ancient seas which have been lifted above their original elevation by geological forces. This notion is an erroneous one. It is absolutely certain, high authorities contend, that the sands of all the great deserts have been formed on the spot by the disintegration of the solid rocks on which they rest. Desert sands correspond in all respects, so far as their mode of origin is concerned, to the dust and sand that accumulates on our high roads in summer. All deserts are situated where the winds from the ocean, before reaching them, are exhausted of their moisture by passing over mountains or across extensive tracts of land.

# Science in the Current Periodicals

## In this Department the Reader will find Brief Abstracts of Interesting Articles Appearing in Contemporary Periodicals at Home and Abroad

### The Traffic Problem in London

THE third annual report of the London Traffic Branch of the Board of Trade has just been issued as a blue book, dealing among other things with the very serious problem of coping with the ever-increasing traffic of this huge city.

The defects of the existing roads are set out in some detail, and suggestions are made as to what measures it would be desirable to take with a view to making good the deficiencies and generally to bringing the main thoroughfares up to the requirements of present and prospective traffic. A *résumé* of the principal points brought out in this blue book is given in a recent issue of *The Engineer*, and is reproduced in part below, together with two accompanying charts:

In the first place reference is made to the increase in population in Greater London, and the fact is recalled that while the population in that area increases as a whole year by year, the increase is much larger in Outer London than it is in the Administrative County. According to the estimates of the Register-General the population of London in 1910—namely, 7,537,196—showed an increase over the population in 1909 of 107,456, of which 38,748 is attributable to the Administrative County and 68,708 to Outer London—equivalent to percentages of 0.8 and 2.70, respectively. This fact, it is pointed out, has a direct bearing upon traffic, inasmuch as it implies a growing demand for traffic facilities of a kind differing from that which would be required were the increase distributed evenly over the two areas.

The longer the delay to take steps to widen and improve the arterial roadways of London and to make new roadways, the greater will be the expense of carrying out the necessary work. Before taking any steps, however, it was necessary in the first instance to obtain an accurate idea of exactly how dense the traffic was on the various main roads leading from the metropolis. The London County Council, which has a staff of men specially trained for this work, was approached and undertook to take the census. A classification of vehicles was settled by consultation with the statistical officer of the Council, the points at which it was desirable to count the traffic were selected, and the first census was taken between January 3rd and February 18th, 1910. To measure the difference in volume and nature between the winter and summer traffic, a second census was taken between June 6th and July 22nd.

The results of these two counts are shown diagrammatically in Fig. 1, in which the width of the darkened portions indicate the relative density of traffic. It will not be necessary to go deeply into the details of the census, further than to say that as far as possible counts made at different points on the same road were made on the same day.

The report lays stress on several points regarding these two censuses. The first is that as each particular count was made on a single day only, it cannot be accepted as representing the true daily average. The volume of traffic varies from day to day and is affected by many circumstances, apart from the season of the year. Still, every precaution was taken to choose days for the counts which were unaffected by abnormal happenings. Then, again, it is pointed out that mere numbers do not serve as a measure of the degree of obstruction caused by vehicles of different classes. For instance, the number of vehicles of all classes that passed Bow Bridge and Shepherd's Bush were found to be practically the same, but reduced to a common standard the traffic at Bow Bridge was found to be the heavier in the proportion of 46.7 to 39.6. To arrive at some uniform basis of comparison, therefore, it became necessary to find a "Traffic Unit" in terms of which every vehicle might be assigned a coefficient, which might have a relation to its size, speed, and flexibility. Accordingly the following classification was adopted:

| Trade Vehicles. | | Passenger Vehicles. | |
|---|---|---|---|
| 1 Horse (fast) | 3 | Electric trams | 10 |
| 1 Horse (slow) | 7 | Omnibus (horse) | 5 |
| 2 Horse (fast) | 4 | Omnibus (motor) | 3 |
| 2 Horse (slow) | 10 | Cabs (horse) | 2 |
| Motor (fast) | 2 | Cabs (motor) | 1 |
| Motor (slow) | 5 | Carriages (horse) | 2 |
| Barrows | 6 | Carriages (motor) | 1 |
| | | Bicycles | ½ |

It is explained that this classification can only be regarded as approximate, since the various vehicles differ among themselves. Still, it is a basis to go on, and it is that which has been used in the preparation of Fig. 1.

The roadways in London to-day are, as a rule, no wider than they were a hundred years ago, and in the meanwhile encroachments have been suffered to grow up which have added greatly to the difficulty in widening. "There is now," says the report, "not a single road leading into London which, in some parts of its course, is free from serious defects, arising either from the conditions of the road itself, or from the volume of traffic which it has to carry. Within the last few years, owing to the great increase in the population, especially in Outer London, to the introduction of electric tramways, and, more recently, to that of motor traffic, the use of the roads has increased to such an extent that all the main approaches to London are overtaxed, and the situation which existed prior to the advent of railways has been introduced in an aggravated form." The report considers that the space occupied by tram lines in busy thoroughfares ought not to be regarded as available for ordinary traffic, and in such situations should not be treated as part of the roadway.

In laying out the width of an arterial road in London it will, it is stated, be necessary to adopt standards considerably in advance of those that were accepted as sufficient in the past. Where the frontages are occupied by shops and business houses allowance must be made for standing and slow-moving vehicles which practically take up the width of a single line of traffic on each side. In addition to these two, and to the space occupied by tramways, an arterial road should be wide enough for at least two lines of moving vehicles on each side of the tram lines, in order that fast traffic may pass unchecked at normal speed. Thus the roadway of a main thoroughfare with shops on both sides ought to accommodate a double line of tramway and six lines of ordinary traffic—three on each side. In extreme cases it may even be necessary to allow for four lines of traffic on each side. Assuming that each line of traffic requires 8 feet 6 inches, and giving a corresponding width to the footways, the figures given in the following table are arrived at:

| | Roadway. ft. | in. | Footway. ft. | in. | Total. ft. | in. |
|---|---|---|---|---|---|---|
| Two tramlines and four lines of traffic on each side | 85 | 0 | 40 | 0 | 125 | 0 |
| Two tramlines and three lines of traffic on each side | 68 | 0 | 32 | 0 | 100 | 0 |
| Two tramlines and two lines of traffic on each side | 51 | 0 | 29 | 0 | 80 | 0 |
| Two tramlines and one line of traffic on each side | 34 | 0 | 20 | 0 | 54 | 0 |
| Three lines of traffic without tramways | 25 | 6 | 17 | 0 | 42 | 6 |

These dimensions, says the report, are obviously subject to variation, but they serve to show the widths that should be aimed at, and point to the following standard of widths for roads of different classes in the neighborhood of London:

| | |
|---|---|
| Main roads, not less than | 100 feet |
| First-class county roads, either radiating or connecting places of importance | 75 feet to 100 feet |
| Second-class county roads | 50 feet to 75 feet |
| First-class district roads, connecting villages or forming branches of main county roads | 35 feet to 50 feet |
| Second-class district roads, mostly country lanes | 25 feet to 35 feet |

Having arrived at this classification, the report next

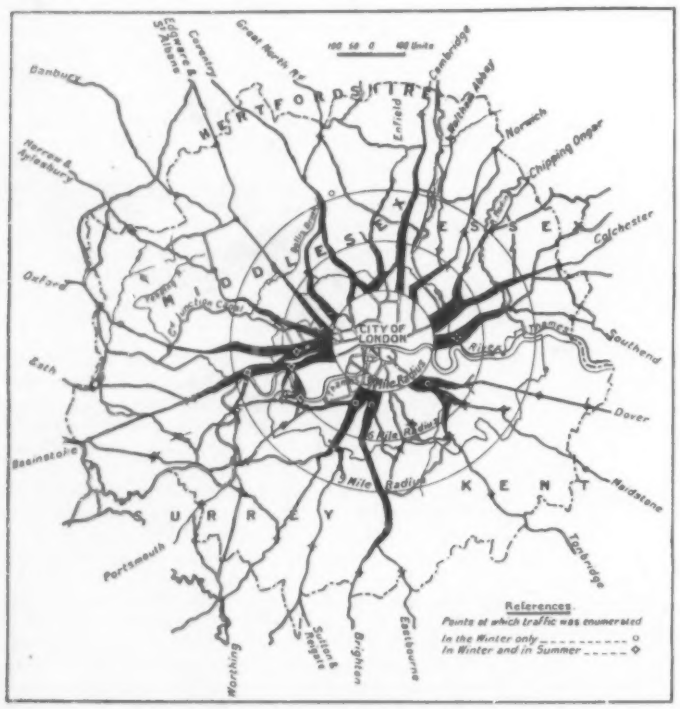



Fig. 1.—CHART SHOWING DENSITY OF TRAFFIC

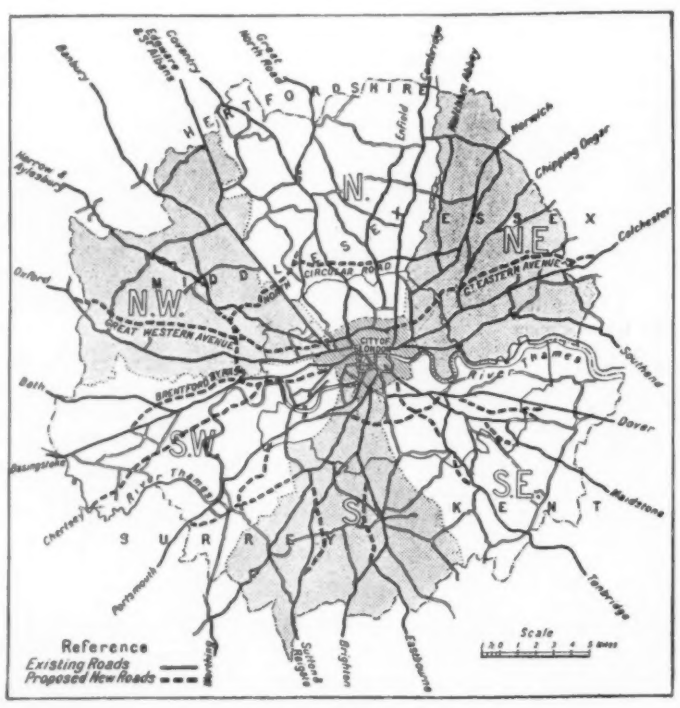



Fig. 2.—CHART SHOWING PROPOSED ROADS

proceeds to consider the various main roads radiating from Greater London into the surrounding country.

These roads, numbering twenty-three, are all discussed in detail for a good many miles out from the center of the metropolis. The suggested improvements and the new roads are for the most part shown by dotted lines in Fig. 2, taken from the report, though certain of the suggestions have not apparently been included. The most important of the new roads as regards length are the Eastern Avenue, 10.4 miles; the Western Avenue, 13.1 miles; the North Circular Road, 8.5 miles, and the Chertsey Road with its extensions, 11.5 miles. The suggestion is to make in all 99.9 miles of new road and to improve 25.45 miles of old road, making a total of 125.35 miles.

The construction of several new bridges and the reconstruction of some existing bridges are included in the suggestions.

Remarking on these figures the report says that the cost of providing 100 miles of new roads, and of improving 25½ miles of existing roads within the Metropolitan area, in addition to extensive widenings of other existing roads, would, of course, be very large; but, it continues, "it is difficult to see how it can be avoided if congestion is to be relieved, and proper provision made for the needs of the future. Large as the expense may be, it should be remembered that the cost of inaction is also heavy. The time lost daily by millions of people through insufficient road accommodation is alone equivalent to a loss of money, which, though impossible to estimate with accuracy, must be very large. It should further be borne in mind that the longer the improvements are postponed, the more costly they will be."

## Applications of Chemistry to Public Welfare

A MOST interesting and valuable survey of the essential aspects of the work of the Bureau of Chemistry, Department of Agriculture, has recently been given by Dr. Wiley on the occasion of his acceptance of the Elliott Cresson medal conferred upon him last December. The eminent chemist said in part:

"One of the first investigations undertaken in the realm of agricultural science was a study of the conservation of and waste of plant food. Long before the present vogue of conservation came into existence important studies in the conservation of plant food were planned and executed. These studies were crystallized in two addresses delivered, the one in 1886 before the Chemical Section of the American Association for the Advancement of Science, on 'The Economical Aspects of Agricultural Chemistry,' and the other as presidential address before the American Chemical Society in 1893, on 'The Waste and Conservation of Plant Food.' In the summary of the data in the address on the economical aspects of agricultural chemistry the following statements are made:

"'*Future Food Supply.*—Since, with a proper economy, the natural supplies of potash and phosphoric acid may be made to do duty over and over again, and last indefinitely, the economist who looks to the welfare of the future need have no fear of the failure of these resources of the growing plant. Indeed, it may be said that the available quantities of them may be increased by a wise practice of agriculture based on the teachings of agricultural chemistry.

"'But with the increase of population comes an increased demand for food, and therefore the stores of available nitrogen must be enlarged to supply the demands of the increased agricultural product. It is certain that with the new analytical methods many series of experiments will be undertaken, the outcome of which will definitely settle the question of the entrance of free nitrogen into vegetable tissues. If this question be answered affirmatively, agricultural science will not place bounds to the possible production of foods. If the nitrifying process does go on within the cells of plants, and if living organisms do fix free nitrogen in the soil in a form in which at least a portion of it may be nitrified, we may expect to see the quantities of combined nitrogen increase *pari passu* with the needs of plant life.

"'Thus even intensive culture may leave the gardens and spread over the fields, and the quantities of food suitable for the sustenance of the human race be enormously increased.'

"Among the closing paragraphs of the address on the waste and conservation of plant food, are the following:

"'Through the ages of the past, the rich stores of plant food have been steadily removed from arable fields and apparently forever lost. But in point of fact no particle of it has been destroyed. Even the denitrifying ferments described by Springer, Gayen and Dupetit, and Muntz, reduce only to a lower stage of oxidation or restore to a gaseous form the nitric nitrogen on which alone vegetation can feed. But electricity, combustion, and the activity of certain anaerobic ferments herding in the rootlets of legumes and other orders of plants, are able to recover and again make available this loss. . . .

"'The fact that a few million years may supervene before the particle that is carried off to-day as waste may return to organic life, shows the patience rather than the wastefulness of nature.

"'As a result of this general review of the migrations of plant food, the reassuring conclusion is reached that there is no danger whatever of the ultimate consumption or waste of the materials on which plants live. Circumscribed localities, through carelessness or ignorance, where once luxuriant crops grew, may become sterile, but the great source of supply is not exhausted. In fact, as the rocks decay and nitrifying organisms increase, the total store of plant food at the disposal of vegetation may continue to grow. When we join with this the fact that the skill of man in growing crops is rapidly increasing, we find no danger ahead in respect of the quantity of human food which may be produced.'

"It is evident that plants, like animals, cannot thrive without proper care, and food is just as important in the development of high-grade plants and abundant crops as it is in the production of high-grade cattle and sheep. The soil was regarded for many centuries as dead matter, containing certain stores of plant food, but one of the first things observed in these investigations which were made was that soil is a living body and as such entitled to have a hygiene and physiology of its own. The study of the soil thus becomes not alone a problem in mineral chemistry, but a biological problem of the highest importance and significance. In the Bureau of Chemistry were made the first systematic studies in this country of the organisms of the soil which produce nitric acid, one of the most important elements of plant food.

"Elaborate experiments were conducted in a series of pot cultures to establish the conditions of maximum activity of nitrification and the relative nitrifying power of different soils, samples of which were taken under such conditions as to insure normal bacterial activities. These led to the important observation that the chemical composition of plants when mature was influenced in the most remarkable degree by the environment to which they were subjected, and that the influence of the soil in determining the quality of the plants was far less significant than had usually been supposed.

"An extensive investigation was undertaken on the influence of environment upon the composition of wheat and other cereals, upon the production of the maximum amount of sugar in the sugar beet, and upon the distribution and qualities of the best varieties of green sweet corn, cantaloupes and other crops. The plan of investigation followed in these studies is, it appears, original and has now been very closely adopted in Australia and some other countries. Briefly, the plan of study was to distribute the same seed in widely different localities and have these seeds planted and cultivated in as nearly as possible the same manner. After being properly harvested and cared for, the crops were chemically examined and compared with crops grown in the mother state. It is evident that in this way the differences in composition were not due to any inherent properties, that is, due to heredity, but to the forces of the environment under which the crops were produced. Several elaborate monographs have been published on this subject, and among these the one of the greatest economic significance is the result of the studies, covering more than fifteen years, on the effect of the environment upon the production of the maximum quantity of sugar in the sugar beet. As a result of these prolonged studies a biological map of the sugar beet area was constructed, indicating by a shaded band stretched from the Atlantic to the Pacific those areas in the United States where the richest sugar beets would be likely to grow. The practical benefit of this study is shown in the fact that many intending investors who were about to place their capital in beet sugar enterprises in unpropitious localities were deterred from doing so by the results of these studies, and thus hundreds of thousands of dollars were saved which otherwise would have been squandered. The most remarkable practical demonstration, however, of the value of such studies from an economic point of view is in the fact that practically every beet sugar factory which has been successful and which is now operating is located in the shaded belt marked out now almost fifteen years ago. The studies of all the factors in the production of a sugar beet of maximum sweetness has led to the conclusion, based upon indubitable data, that the dominant factor is a long day and a moderate temperature, not varying very much from an average of 70 deg. F. for the three growing months of June, July and August. It is evident, therefore, that a high northern latitude, combined with a proper distribution of water by irrigation or otherwise, is the only place where a sugar beet can be grown at the present time which can compete with European grown sugar.

"These are only some of the more important of the many biological investigations which have been conducted in connection with the growth of crops and the increase of the food supply of the country. The activities of the Bureau of Chemistry, however, have not been confined to plant life. The highest service of science is to man himself, and the welfare of the plant and of the animal, from an ethical, moral and economic point of view, may have their highest significance in their relation to the welfare of man. To this end a great deal of the energy which has been expended in the investigations of the Bureau of Chemistry has been directed to problems involving human rights, the health of the people and the honesty of trade.

Under the old principle of the common law the purchaser himself was held responsible for investigating the character of the goods he bought, and this led to the maxim of the common law of *caveat emptor*. The statute of law, however, recognizes the helplessness of the purchaser in most cases to make such investigations and so under this law the legend has become *caveat vendor*. Especially is this true in respect of those who by reason of a tender age are incapable of looking out for themselves. In the case of infants' foods the duty of the State and municipality is plain. The only artificial food an infant deprived of its natural food should have is pure, fresh milk modified to be as much like mothers' milk as possible. Experience has shown that the death rate of artificially-fed infants can be materially reduced by a pure milk diet. What greater service may a municipality render its citizens than to save the lives of the children? It seems that the only immediate solution of the problem is the city-controlled milk supply for sick and motherless children. The city should own its own herd of healthy cows, kept in the best sanitary manner. The milk should be handled by the latest methods of transportation and delivered promptly to the consumer. It should be made an offense of the law to feed a de-mothered infant under one year of age any food save the pure modified milk. A charge equal to the price of ordinary milk should be made for the municipal milk, which should be reserved solely for infants' use."

## Effect of Radium Emanation on Plants

RADIUM produces by its spontaneous disintegration a gas which is usually called radium emanation, but for which Sir William Ramsay suggests the name *niton*, derived from a Greek word which signifies brightness. Niton or radium emanation is a radioactive chemical element which disintegrates rapidly and has a very brief existence.

Fabre has communicated to the French Biological Society the results of his experiments on the effect which the radiations of the emanation produce on germination and growth in various vegetable organisms. One of the organisms selected was black mold (*Stengmatocystis nigra*). The "optimum" or most favorable dose of radiation, which developed the mold in four days, was found to be ½ microcurie per cubic centimeter of air. (The curie is the unit of radioactivity and the microcurie is one millionth of that unit.) The "abiotic" dose, which kills the black mold, is 1 microcurie or more per cubic centimeter.

For the common white mold (*Mucor mucedo*) the optimum dose is 1 microcurie per liter of air. In the case of *Lilium catharticum* the dose most favorable for germination and growth is ¾ microcurie per liter of air, while this species of lily is killed by 40 microcuries per liter of air.

## A Device for Diminishing the Rolling of Ships

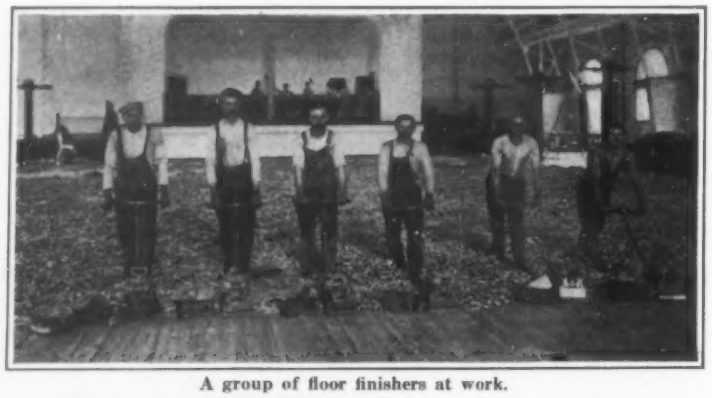
THE German engineer Frahm has devised a method of diminishing the rolling of ships, which is the principal cause of seasickness. A water tank is placed on each side of the vessel, and the two tanks are connected by a pipe provided with any suitable device for varying its effective cross-section and the frictional resistance opposed to the flow of water. In this way the oscillation of the mass of water from side to side can be regulated, in period and phase, so that it is opposed to the rolling of the ship, which is thus diminished.

According to the *Revue des Sciences*, the Frahm apparatus has been installed on two 12,600-ton steamers of the Hamburg-America Company, the "Ypiranga" and the "Corcorado." The tanks contain 195 tons of water, and greatly diminish the rolling; for example, from 11 degrees to 2½ degrees on each side of the vertical. In consequence of this successful result the system will be installed on the new colossal vessel of the Hamburg-America Line, the "Europa." A similar device was tried on the British warship "Inflexible" in 1883, by Sir P. Watts.

# Curiosities of Science and Invention

## Spring-driven Floor Smoothers

ONE of the most difficult problems of the builder is that of floor scraping, and it is of the utmost importance that the work should be well done, as there is nothing about an apartment or hall that stands out more prominently than the floors, which if well finished are very pleasing to the eye. A number of practical floor surfacing machines have been devised. The type seen at work in the accompanying illustration is provided with powerful motor springs which aid the operator in a most effective and simple way. The spring gathers tension on the forward stroke and furnishes sufficient power on the return or cutting stroke to overcome the back breaking pull experienced in the use of dead weight machines. There are two detachable weights used with the floor smoother, both weights being slotted so that they can be adjusted to bring any desired pressure to bear upon the scraper blade, the weights weighing about 150 pounds. A sand-papering attachment is employed with the machine, weighing complete 90 pounds without the scraper weight. The sander has a rounding surface and works with a rocking motion which automatically clears the dust from the sand paper.



A group of floor finishers at work.

## A Catamaran in a Suit Case

A PARISIAN inventor has designed a catamaran which may be folded up into so small a compass that he can place it in a wooden box no larger than a suit case. In fact, the case forms the shell of the catamaran. The two sections of the case are secured end to end, and by means of bolts and thumb screws, three cross bars are attached to the shell, with the outer ends secured to a pair of light wooden girders. A small seat is erected at one end of the shell. The cigar-shaped floats of the catamaran are made of water-proof material, which may be packed into a small compass when not in use. In assembling the boat, however, the floats are inflated by means of bicycle pumps. The girders are secured to the floats by means of straps. The paddle used with the catamaran is jointed so that it may be folded up and placed in the case. The weight of the entire boat is very small, and it is capable of fair speed. The inventor of this catamaran does not need to worry about boathouse privileges, for he can carry his boat with him to and from his home.

Carrying the boat to the water.

Afloat in the catamaran.

Inflating the cigar-shaped floats.

## A Singular Motor Truck Accident

A REMARKABLE accident to a motor truck occurred at Reading, England, a while since. The driver of the truck was endeavoring to turn around in somewhat close proximity to a river, when in some way or other he lost control of the vehicle, and more than half of the machine slid back into the stream. The driver and another man were both thrown into the stream, but fortunately escaped. The problem of getting the car out of the water was a difficult one, but was successfully solved by placing a platform round the rear and then hauling it up on the supporting planks by means of a traction engine operating a pulley. Some idea of the difficulty of the business may be gathered from the accompanying photograph.

Rescuing a motor truck.

## Automobile as Horse-clipper

A MOST ingenious use for the automobile has been found by a veterinary surgeon of Portland, Oregon, who uses his little runabout as a horse-clipping power plant. Of course, this device has the double advantage of carrying him quickly to the place where he expects to operate and, once on the ground, the rear wheel is jacked up as shown in the photograph. A thirty-foot length of ordinary manila clothes line is used as a belt connecting the car wheel with the clipper. Then the engine is started, and in about a quarter of the time it takes to do it by hand the horse gets a hair cut from forelock to hoof.

Clipping a horse with the aid of an automobile.

## The Evolution of Khaki

A LUCKY accident led to the invention of khaki, that olive-colored cloth that is worn by soldiers.

For years the British troops in India wore a cotton cloth of a greenish brown, but it always faded when washed with soap. While discussing this defect with some British officers, business man from England carelessly observed that the manufacturer first to discover the means whereby a cotton drill could be made that would not fade would certainly make his fortune. One of the officers, a young man, took the hint. When he got home he employed a skilful dyer, and the two began a systematic search for an olive dye that, when used on cotton cloth, would not yield to soap or soda. They spent years in experiments along this line, but to no avail. The thing seemed hopeless.

One day, however, they found among numerous scraps of dyed cloth one that retained its color under the most severe tests. The puzzling part of it all was that this scrap had been derived from a piece of cloth that had been subjected to the same processes. For a long time the experimenters tried to solve this riddle. The one bit of cloth of khaki mentioned was the only piece that kept its color against all attacks.

Finally, by the merest chance, they hit upon the secret. The dye in which this scrap had been dipped had remained for a time in a metal dish of a peculiar kind. This metal, in combination with the chemicals of the dye, had furnished the very thing needed. They made the experiment with other pieces; the dye held, and their fortunes were made.

## A Prehistoric Needle Factory

NOT so long ago much interest was awakened in England by the discovery of a prehistoric lake village near Glastonbury. The dwellings were placed on mounds of clay raised above the level of the water. The framework of a primitive loom was found under one mound, and the number of broken bone needles and bone splinters discovered in another mound led the explorers to think that it may have been the site of an ancient needle factory. Very few human bones have been discovered, but among the interesting finds is a blue glass bead, with a waving dark line running around it. One of the mounds contains three hundred tons of clay, all of which must have been dug from the surrounding hills, and carried to the spot in boats.

## Tallest of Trees

IN New South Wales, Victoria and Tasmania grows a species of gum tree, *Eucalyptus amygdalina*, which probably represents the tallest of all trees of the globe.

The loftiest specimen of this tree yet measured towers to the height of four hundred and seventy-one feet. A prostrate tree, measured in Victoria, was four hundred and twenty feet long, and the distance from the roots to the lowest branch was two hundred and ninety-five feet. At that point the trunk was four feet in diameter, and three hundred and sixty feet from the butt the diameter was still three feet. The wood of this tree is hard and of good quality, it grows quickly, and yields a great quantity of volatile oil from its leaves, which are very abundant.

# The Heavens in May

## Our Monthly Astronomical Page

By Henry Norris Russell, Ph.D.

WIDELY as the stars appear to our eyes to differ in brightness, their real differences are yet greater. Even if we pick out a number which look of the same general degree of brightness, we find, when we attempt to measure their distance, that some are enormously more remote, and hence must be enormously brighter, than others which look to us their equals. How great these differences are is well shown by the following list, which includes the brightest stars in the sky, which can be described with tolerable accuracy as of the first magnitude. All these have been very carefully observed for parallax—often by several observers—and in most cases we can make at least a good estimate of their distance. Though some of them are so far off that, even though we have a base-line 186,000,000 miles long for our range-finding, the convergence of lines drawn from its two ends to the star is too small to be measured.

The stars are arranged in order of their apparent brightness in the sky in the second column. Following the name of each star is given the amount of light *which we receive* from it (taking Sirius, the brightest of all, as 100). Next follows the distance in light-years, derived from the average of all available determinations of parallax (recently collected by Prof. Kapteyn). The uncertainty of the observed values is very different in different cases. The few disturbances under the ten light-years are not likely to be, on the average, more than 5 per cent in error; but the percentage of error increases in proportion with the distance, those of 50 light-years being subject to average errors of some 25 per cent of their value, those of 100 light-years to errors of 50 per cent, and those of 200 light-years and upwards being as yet impossible to determine with any certainty.

The last column gives the actual luminosity of these stars—i. e., the amount of light which they send out—our sun being taken as a standard. These are subject to a percentage of uncertainty double that which affects the distances.

As many stars are double, a second column gives the luminosity of their companions, many of which are very faint. The pole-star, though well below the others in brightness, is added on account of its general interest.

### THE BRIGHTEST STARS.

The diversity in the real brightness of these stars, which look so much alike to us, is very striking. Canopus appears to us only twice as bright as Alpha Centauri, but really exceeds it several thousand fold. Rigel, which seems to us but one-sixth as bright as Sirius, is really something like a hundred times brighter. Its "faint" companion—shown by telescopes of moderate power—which appears as a mere speck of light in comparison with Rigel itself, is really brighter than Procyon or Altair, and very likely exceeds Sirius in luminosity.

On the other hand, some of the nearer stars have faint companions which give but a very small fraction of the sun's light. Such faint stars are not at all exceptional—there are dozens of them known to be within 50 light-years of our solar system—but even the nearest of them appear faint to us, and so do not come into a list of bright stars unless by the accident of being companions to a brighter primary.

The three southern stars which are bracketed together in the table belong to one of the remarkable star-streams discovered by Prof. Kapteyn. They are all moving in the same direction, at about the same rate, as are many fainter stars in this part of the sky. From a study of these motions, aided by spectroscope observations, it will soon be possible to determine the distances with considerable accuracy. The values given above are only approximate.

Of the twenty-two stars of our list (besides the Pole-Star), eight are now well visible in the evening sky, and three more are rising or setting. Looking due west, at the hour mentioned at the foot of the map, we find Castor and Pollux close together and nearly on a level. Procyon is some distance to the left and a little lower down, and Capella is a little farther away on the right. Below Castor and Pollux early in the evening we may see the red Betelgeux, the last bright star of Orion to set.

| Name. | Light Which We Receive. | Distance in Light Years. | Actual Light in Terms of the Sun's | |
|---|---|---|---|---|
| | | | Bright Star. | Companion |
| Sirius | 100 | 8.6 | 48.0 | 1/26 |
| Canopus* | 51 | over 200.0 | over 10,000 | .... |
| Alpha Centauri* | 24 | 4.3 | 2.0 | 0.6 |
| Vega | 21 | 35.0 | 100.0 | .... |
| Capella | 19 | 50.0 | 300.0 | .... |
| Arcturus | 19 | 43.0 | 220.0 | .... |
| Rigel | 17 | over 200.0 | over 4000 | over 20.0 |
| Procyon | 15 | 10.0 | 10.0 | 1/6.5 |
| Achernar* | 13 | 65.0 | 350.0 | .... |
| Attair | 10 | 14.0 | 12.0 | .... |
| Betelgeux | 10 | 110.0 | 1400.0 | .... |
| Beta Centauri* | 10 | about 100.0 | 350.0 | 200 |
| Alpha Crucis* | 9 | | 600.0 | .... |
| Beta Crucis* | 6 | | 300.0 | .... |
| Aldebaran | 9 | 45.0 | 110.0 | 1/50 |
| Spica | 7½ | over 200.00 | over 2000 | .... |
| Pollux | 7½ | 50.0 | 125.0 | .... |
| Antares | 7½ | 200.0 | 2000.0 | 10.0 |
| Fomalhaut | 7 | 23.0 | 25.0 | .... |
| Alpha Cygni | 7 | over 200.00 | over 1800 | .... |
| Regulus | 7 | 100 0 | 420.0 | 1.0 |
| Castor | 6 | 40.0 | 55.0 | 25.0 |
| Polaris | 3½ | 70.0 | 100.0 | 1/5 |

* Invisible in the latitude of New York.


At 11 o'clock: Apr. 7.
At 10½ o'clock: Apr. 14.
At 10 o'clock: Apr. 22.

At 9 o'clock: May 7.
At 8½ o'clock: May 15.
At 8 o'clock: May 22.

At 9½ o'clock: April 30.

**NIGHT SKY: APRIL AND MAY**

The very brilliant object in the northwest, far exceeding any of the stars, is the planet Venus. She is steadily moving eastward among the stars—that is, apparently upward and to the left—from night to night. At the end of the month she is close to Castor and Pollux, making a very fine group.

In the southwest and higher up is Regulus, at the end of the handle of the "Sickle," a group of stars that can be identified at a glance. Far to the left, somewhat east of south, and lower down, is Spica. Arcturus, known by his great brightness and yellow color, is high up, a little south of east.

The very bright body in the southeast is the planet Jupiter, second only to Venus. Below him, and somewhat to the left, Antares is rising, and will become conspicuous in an hour or two.

Vega is low down, almost due northeast, and Alpha Cygni is on the horizon, still farther to the left.

Having picked out these stars, or even a few of them, the map makes it very easy to trace out the other constellations, of which the most prominent are Cassiopeia, low in the north; Draco, high in the north and northeast; Ursa Major, almost overhead; Corona and Hercules, in the east, and Hydra, in the south.

In its enormous length, about one-fourth of the whole circumference of the heavens, this huge constellation is indeed comparable to the fabled sea-serpent at its best. It is not difficult to trace out a rather sinuous line of stars, beginning with a small but fairly conspicuous group about half-way between Procyon and Regulus, passing southwards to an isolated bright star, Alpha Hydræ, sometimes known by the name of Alphard, and running on its line, sometimes marked by faint stars, below Spica, almost to the border of Scorpio.

On the back of this serpent stand two utterly unrelated objects, a Cup and a Crow. Both are ancient constellations, their names dating from classic times. The first is inconspicuous, but consists of a semicircle of small stars which bears some resemblance to a cap or bowl. The second, Corvus, is fairly conspicuous, but bears not the slighest resemblance to a crow, its principal configuration being an irregular quadrilateral of stars of the second and third magnitudes, whose northern side points almost straight toward Spica.

Observers south of 28 deg. north latitude—that is, in Florida, Southern Texas, and southward—can at this season see the Southern Cross, low on the horizon. The Cross is almost exactly south of Corvus, and is best seen when this constellation is on the meridian. About an hour later, when Spica is due south, two very bright stars may be seen a little east of south, as low as the Cross, and pointing towards it. The one farthest east is Alpha Centauri, our nearest neighbor in the heavens.

### THE PLANETS.

Mercury is evening star—theoretically—till the 5th, when he goes through conjunction with the Sun, and narrowly escapes a transit, passing apparently within some five minutes of arc (or one-sixth the Sun's diameter) of the Sun's edge. He is visible to the naked eye only as a morning star at the end of

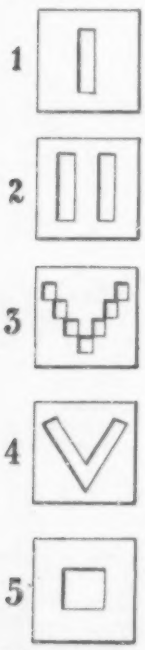
(Continued on page 438.)


[The Editor of the Home Laboratory will be glad to receive any suggestions for this department and will pay for them, promptly, if available.]

## Experiments on Light

By Sydney W. Ashe

INTERFERENCE.—The principle of interference of light rays may be prettily shown on a screen in a darkened room by means of the following simple apparatus: Obtain some ordinary lantern slide glasses and cover them with passepartout paper, except the figures which are indicated in the illustration. No. 1 is a single slit; No. 2 consists of two slits; No. 3 a set of "V" shaped steps; No. 4 a wide "V," and No. 5 a wide slit. These slides should be placed one at a time in the slide carrier of a projecting lantern, and a carbon bisulphide prism should be placed before the objective lens. Fig. 1 obviously will produce a single spectrum on the screen. Fig. 2 will likewise produce two spectras, the violet of one spectrum being adjacent to the red of the next spectrum. Fig. 3 will produce a series of spectra, each little square having its individual spectrum. Fig. 4, if the angle of the "V" is correct, will form a "V" shaped spectrum, the colors running parallel to each other. This will show that the complementary colors will be over each other. When slide, Fig. 5, is used it will produce on the screen a similar slit having fringes of color; the beginning of the spectrum will be on one side, say to the left, the center will be white, due to the interference of the various colors, and on the other side, to the right, the other end of the spectrum will be found. The effect is as though the normal spectrum had been stretched out, the center being filled in with white.

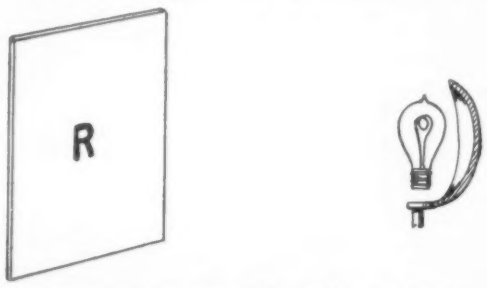



**Slides with various openings for spectrum experiments.**

SPECTRA OF ARCS.—If the objective lens of a projecting lantern is removed, a slit placed in the slide carrier, and the arc moved back, it will be possible to project the arc magnified many times on the screen. If a right-angled head lamp is used it will be possible to focus the crater on the screen, and see the molten carbon in a state of ebullition. With the ordinary carbon arc it will be noticed that no illumination is given off by the arc flame. If a prism is placed before the lantern when the objective lens is in place a spectrum will result, which approaches quite closely to day light. If a pair of flaming arc carbons are used in the lantern and projected on the screen it will be noticed that the illumination is given off by the arc flame. If the spectrum is projected on the screen the characteristic bands of calcium will appear. If a magnetite electrode is used in the lantern and projected on the screen, it will be noticed that practically all of the illumination is given off by the arc flame, and it will produce a large number of narrow bands extending all over the spectrum forming the characteristic scale for iron.

It is interesting to note that the character of the negative electrode determines the color and luminosity of the arc. For instance, two kinds of electrodes such as a carbon and a magnetite electrode may be used, the lantern being connected through a reversing switch. When current is passing through the electrodes in one direction the characteristic spectrum of the material forming the negative electrodes will be projected with a prism on the screen, and when the reversing switch is thrown in the opposite direction changing the polarity of the carbons the characteristic spectrum of the other carbon, the negative will be projected on the screen.

ACUITY.—The tendency in all modern illuminating schemes is to keep the illuminant out of the field of vision, as it is found that an individual's ability to read decreases as the visual angle between the light source and the object decreases. For an angle of eight degrees an individual's acuity is decreased about thirty per cent. This may be proven experimentally by erecting a white chart on which is placed a small letter about one-eighth inch in height, such as the letter "R." Illuminate this chart with an ordinary candle or incandescent lamp which is screened from the eye of the observer. This experiment should be performed in a darkened room. The individual should come forward toward the chart until he is quite able to read the letter, and he should note his distance from the chart. The candle power of the light source divided by the square of the distance of the light from the screen will give the intensity of the light on the screen. Thus a 16 candle-power lamp




**Arrangement of lamp and screen for experiment in visual acuity.**

4 feet from the screen will be $16/4^2=1$. When the observer has taken his reading he should light a small candle alongside of the chart, so placed that it will not illuminate the chart, and then he should repeat his reading. He will find that it will be necessary to come much nearer the screen in order to read the same letter when illuminated by the same foot candle intensity.

## Copper Connections for Battery Carbons.

By A. J. Jarman

WHEN one attempts to make up a galvanic battery where a carbon plate or rod forms the negative element, he must face the problem of forming a good sound connection with the electrode. Very often the failure of a so-called dry battery is due to the want of a good carbon connection.

The method described here is the one that the writer has employed in very powerful primary batteries of the bichromate type, at all times with complete success on as many as 44 cells coupled in series, as well as for the so-called dry or semi-dry batteries. The principle has therefore been put thoroughly to the test, and can be relied upon. It consists in copper plating the end of the carbon and soldering the connection to the copper.

The first thing to be done is to make a wooden trough with as many divisions or cells as there are carbon plates to be prepared. Fig. 1 is a photograph of a small trough, made from a piece of board 5 inches wide, 10 inches long, and ½ inch thick, with strips of wood nailed upon the top so as to make four cells, 1 inch deep. The whole is then coated over with shellac varnish twice, allowing the first coating to become set hard before the second coating is applied. Two good cells of a primary battery will be required (*not dry cells*); two Bunsen's or a battery such as described in the SCIENTIFIC AMERICAN of May 28th, 1910. Now procure as many carbon plates as needed (Fig. 2 shows only four) and fit up several connectors with copper wire to a spring clip at the top and a U-shaped copper strip at the bottom, and arrange them in the trough as shown in Fig. 2. An excellent size of carbon plate for almost any purpose is 7 inches long, 2 inches wide, and a ¼ inch thick. Those shown in Figs. 3 to 5 are of this size. Now adjust these carbons as shown in Fig. 2, so that the current will flow from the carbon element

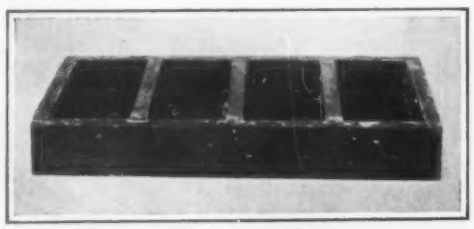


**Fig. 1.—Trough in which plating is done.**

of the battery through the wire that has a piece of sheet copper soldered to it, so as to form the anode, while the wire from the zinc element of the battery is attached to the last carbon by the tin plate clip as shown. Make up a solution of sulphate of copper five ounces to a pint of water, and add two ounces of common sulphuric acid. When *all* the crystals of sulphate of copper have become dissolved, and the solution has cooled down, pour enough into each depositing cell to stand about half an inch high. Assuming that the battery is charged and connected, as soon as the solution is poured into the last cell deposition of copper will take place slowly upon the ends of each carbon plate. The deposit must not be allowed to take place too rapidly. If the deposition is rapid because of too high a temperature of the liquid or the room, reduce the current, using one cell only. In the course of about one and one-half to two hours a beautiful bright rose colored deposit

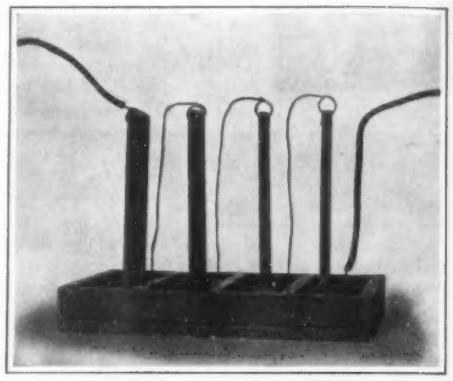
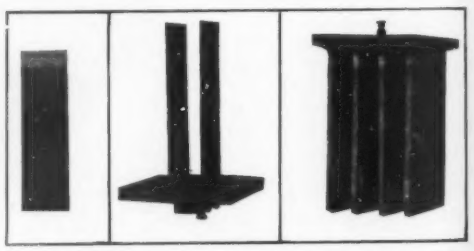


**Fig. 2.—Carbons in the plating bath.**

of copper will be found all over the end of the carbon plate. The battery connection may be undone and the carbon plates removed and dipped into hot water for a minute or two, so as to wash out the copper sulphate. Then the plates should be stood upon blotting paper in a warm place to dry.

Just as soon as they are completely dry, the coppered ends can be tinned by brushing a solution of chloride of zinc over them and applying a well heated copper bit or soldering iron with a small quantity of solder. The whole operation of tinning can be done in half a minute or less. In this condition a strip or plate of copper of any shape or size to suit requirements can be attached by a good soldered joint. The carbon with its soldered attachment must now be well washed in hot water to get rid of any of the chloride of zinc. As soon as the carbon has become thoroughly dry and cool it must be dipped into melted paraffin and held there until it is observed that the paraffin has crept above the coppered part, about half an inch or more. Then remove the plate and stand it, with its joint downward, upon a piece of board, and allow it to remain in this position until the paraffin has become set. When cold wipe off the excess of paraffin with a rag wetted with benzine, and paint every part of the metal with shellac varnish to half an inch below the joint.



**Figs. 3 to 5.—Examples of plated and mounted carbons.**

In cells where salammoniac, sulphate of ammonia or dilute solutions of sulphuric acid and the bichromates of potash or soda are used this form of connection is perfect, but it cannot be used with nitric acid solutions. In the course of many months working the elements may require a little scraping around the joint, and a second dipping in paraffin, but such connections have been used in many batteries and lasted as long as three years without any attention or repair. The carbon elements for a powerful battery can be made up from the size described by soldering them side by side upon a copper base, and double or triple elements can be formed, so as to use two or more zinc plates in a single cell.

Figs. 4 and 5 show the carbon elements of cells made up from the plates described. Fig. 5 shows the combination of four carbon plates so as to give a large negative surface for a single cell, with slots in the wooden top to admit two zinc plates, thus lowering the internal resistance of the cell considerably. When the carbon elements of a battery are mounted upon a copper top or crown piece an excellent base is provided for fixing the screw terminals by passing the stem through the wooden crown and soldering it beneath to the copper attachment. The element shown in Fig. 5 is one of a set that withstood three years' work without repair.

# The Inventor's Department

## Simple Patent Law; Patent Office News; Inventions New and Interesting

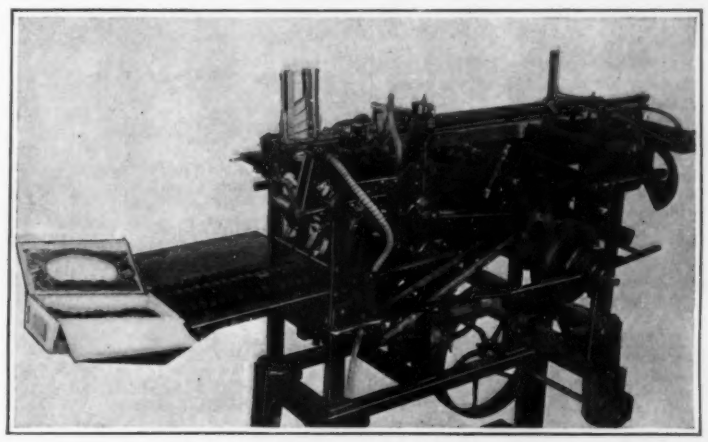
### Banding Cigars by Machine

THE much sought for and hitherto unattained non-refillable bottle has a successful counterpart in the tobacco trade. Cigar bands, to all practical intents and purposes, are non-reusable. The band is applied, not to the container, but to each individual cigar, and when a cigar is smoked, it is almost invariably torn off and destroyed. It is a comparatively simple matter to detect the use of forged labels, and the penalty in case of detection is most severe. Hence, when a cigarmaker puts out a new brand he feels the utmost confidence in the bits of highly-colored and embossed paper girdling each cigar, for upon them he can build up a reputation for the quality of his goods. The public has accepted, nay, it even demands this particular form of guarantee. It is not the only method of protection open to the cigar manufacturer. Some brands of cigars are marked by burning a name in the wrapper with a hot iron, but obviously the efficacy of this method does not measure up to that of a paper band, chiefly because it does not make as attractive a box of cigars. There is no doubt that a pleasing label exerts considerable influence upon the consumer.

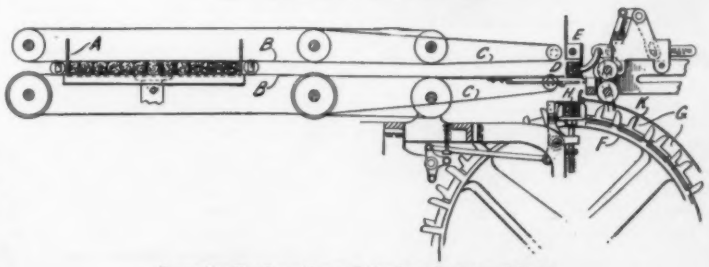
In their endeavor to produce a cigar that will prove acceptable to the smoker, manufacturers have been put to a great deal of expense. Not only are the better grade cigars banded, but also the cheaper brands, and little cigars, and now even stogies are being dignified with a glittering mark of identification. Fully five billion cigars per year, or sixty per cent of the total output in the United States, are banded, and all this work must be done by hand. A veritable army of girls is constantly employed at a cost of nearly two million dollars per year.

At first thought it would seem to be a simple matter to invent a machine that would wrap a band about a cigar and gum it fast. The task would be a very simple one did not the manufacturer have to cater to the dictates of the fastidious consumer, who must have his cigars put up in a variety of shapes and sizes. Indeed, the form of the cigar frequently counts for more than the quality. It is not enough that the cigars are round. They must be packed tightly in the box, so tightly as to be flattened by mutual contact, and herein lies the main obstacle to mechanical handling. The cigars are not all flattened alike. Slight differences in condition or in structure will cause one to yield more under the press than the other, and as a result we have a box of cigars molded together like the lobes of an orange, each varying but slightly from the other in shape, and yet enough to make it next to impossible to restore the original order once it has been disturbed and the combination lost. Now it would be impracticable to band the cigars before they are packed, because in the process of packing they would be crushed, distorted and broken, and would not fit snugly on the cigar, and so it is necessary to band the cigars after they have been molded to the shape demanded by fashion. In order to prevent losing the original order, the box is turned upside down and emptied into a receptacle, bringing the bottom row at the top. Then the cigars are picked up one at a time, banded and returned to the very positions they occupied originally in the box. The rapidity with which this work is done and the accuracy with which the bands are positioned upon the cigar are truly marvelous. Some girls will band as many as six thousand cigars in a day, and with such uniformity that not the slightest waver will show in the alignment when the cigars are placed in the box. The average speed, however, is about three thousand a day. Rapid though this work may be, it is not rapid enough. Sometimes the bands are not put on squarely, sometimes they are not properly gummed, or are put on too loose, and sometimes an unscrupulous operative will skip some of the lower rows of cigars.

Such conditions have been borne patiently for all these years, because no mechanical substitute was brought forth. Not long ago a successful machine was constructed for banding loose cigars, but the banding of packed cigars has been a far more baffling puzzle. Aside from restoring the cigars to their original position, there is the variation of size and form of cigars to be considered. All of these difficulties appear to be mastered in the machine shown in the accompanying engraving. The machine is adjustable to various sizes, whether long or short, whether of small diameter or large, and it will place the band in any position desired upon the cigar. To avoid disturbing the order of the cigars, they are treated much as in the hand operation. The box is inverted upon a receptacle, from which cigars are taken automatically, fed to the banding mechanism and delivered on a platform at the other end of the machine in reverse order, so that they can be repacked in the box. While passing through the machine, the cigars are carefully handled so that there is no danger of injuring the wrapper. At the banding point the cigars are picked up one at a time upon a suction tube and deposited upon the open band, which is then folded about them by means of spring fingers that bear upon the paper without touching the tobacco.



A machine that bands packed cigars.




Longitudinal section of the banding machine.

The accompanying sectional view illustrates the progress of the cigar through the machine. To remove the cigars from the box, a tray is used, formed of a bottom and two sides, which is inverted and closed down upon the cigars with the side walls inserted between them and the ends of the box. The box is then inverted and removed, leaving the cigars upon the tray. This is now placed in the machine in the position shown at the extreme right-hand end of the photograph. A pusher pushes the top layer of cigars, which, by the way, is the bottom layer of the box, between a pair of belts that serve to convey the bands toward the banding mechanism. This conveyer has a continuous motion and feeds the cigars to a second conveyer whose travel is intermittent. The object of the intermittent motion is to separate the cigars by an interval which will permit one to be banded before the next reaches the banding mechanism. At the banding point, the cigar is brought to a position over a band, and then is forced, by means of a plunger, into a socket of a conveyer wheel which is for the moment stationary. The conveyer wheel is provided with teeth that are adjustable so as to form sockets of different sizes to fit different shapes of cigars. As soon as the cigar with the band is pressed into the socket, two spring fingers operate to close the left-hand end of the band over the cigar. The conveyer wheel then rotates, bringing the right-hand end under a guide, which presses it down upon the left-hand end of the band. The right-hand end is either gummed in the machine or else, if gummed labels are provided for the machine, it is moistened previous to being pressed into place. As the conveyer wheel pursues its intermittent motion along the guide, the gum has sufficient time to set and dry. The face of the band lies against the bottom of the socket in the conveyer wheel, and hence it is necessary for the cigar to make a complete turn before it is delivered upon the platform. After making a quarter turn, the cigar is delivered to a chute, which turns it through ninety degrees more, so that it issues upon the table face upward. Here an operator places the cigars in the box in the order in which they issue from the machine, which, of course, is the original order of the packed box.

As soon as one row of cigars has been conveyed clear of the pusher, the tray is elevated sufficiently to bring the next row in line with the conveyer, and this is automatically pushed into the mechanism. Thus the cigars are fed into the machine row by row until the tray is empty, when the mechanism automatically stops, notifying the operator that it is time to place another box of cigars in the tray. The operation of the machine is extremely rapid. It can do in one hour as much as a girl can do in an entire day. To be sure, it requires for its maximum efficiency two operators, one to feed the cigars and the other to repack them in the box. However, this work does not call for any particular skill, and hence is not expensive.

### Legal Notes

**Price Fixing.**—Mr. Justice Hughes of the Supreme Court has recently handed down a decision in the case of Dr. Miles Medicine Company against John D. Parks & Sons Company, involving the general subject of price fixing. In the decision Justice Hughes says:

"The complainant has no statutory ground. So far as appears there are no letters patent relating to the remedies in question. The complainant has not seen fit to make the disclosure required by the statute, and thus secure the privileges it confers. Its case lies outside of the policy of the patent law, and the extent of the right which that law secures is not here involved or determined."

The Court here and in other passages of the decision distinguishes between a product which has patent protection and one outside of such protection. Thus the Court says:

"The complainant relies upon the ownership of its secret process and its rights are to be determined accordingly. Any one may use it who fairly, by analysis and experiment, discovers it. But the complainant is entitled to be protected against invasion of its right in the process by fraud or by breach of trust or contract."

Then again the Court, in distinguishing between the manufacture of the product and its commercial manipulation, says:

"Here, however, the question concerns not the question of manufacture, but the manufactured product, an article of commerce. The complainant has not communicated its process in trust or under contract or executed a license for the use of the process with restrictions as to the manufacture and sale by the licensee to whom the communication is made. Complainant's secret remains intact."

The Court also says:

"But because there is no monopoly of the production, it certainly cannot be said that there is no public interest in maintaining freedom of trade with respect to future sales after the article has been placed on the market and the producer has parted with his title. Moreover, every manufacturer, before sale, controls the article he makes. With respect to these, he has the right of ownership and his dominion does not depend upon whether the process of manufacture is known or unknown, or upon any special advantage he may possess by location, materials or efficiency. The fact that the market may not be supplied with the particular article unless he produces it is a practical consequence which does not enlarge his right of property in what he does produce."

Thus, in the foregoing, the Court distinguishes between the right to manufac-

ture and a party's right in his secret process as against fraud, and the right to control the sale of the product after the maker has parted with his ownership therein.

Now, as to restrictions of sales, Mr. Justice Hughes says:

"But because a manufacturer is not bound to make or sell, it does not follow that in case of sales actually made, he may impose upon purchasers every sort of restriction. Thus a general restraint upon alienation is ordinarily invalid. . . . Nor can the manufacturer by rule and notice, in the absence of contract or statutory right, even though the restriction be known to purchasers, fix prices on future sales. It has been held by this Court that no such privilege exists under the copyright statutes, although the owner of the copyright has the sole right to vend copies of the copyrighted production."

Further on the Court says:

"The advantage of established retail prices frequently concerns the dealers. The enlarged profits which would result from adherence to the established rates would go to them and not to the complainant. It is through the inability of the favored dealers to realize these profits on account of the described competition, that the complainant works out its alleged injury. The complainant having sold its product at prices satisfactory to itself, the public is entitled to whatever advantage is derived from competition in the subsequent traffic."

Associate Justice Holmes of Massachusetts dissented from Justice Hughes's decision and Associate Justice Lurton took no part in the case because he had rendered the opinion below.

**Patent Appeals.**—The Court of Appeals of the District of Columbia on April 4th, 1911, handed down decisions in six patent appeals, three of which were *ex parte* cases and three *inter-parte* cases, and the decision of the Commissioner of Patents was affirmed in all six appeals.

**The Federal Reporter and the Courts.**—A minor feature of the new Judicial Code, but one which will have some interest to our readers, is a provision to purchase sets and continuations of the *Federal Reporter* for the use of the courts and departments of the United States and of the Senate and House of Representatives. The Attorney General is authorized to distribute these sets and digests at each place where a Circuit Court of Appeals or a District Court is now or may hereafter regularly be held. The clerks of the courts are to keep such reports and digests "for the use of the courts and the officials thereof." This measure has been pending before Congress for several years. The original bill was introduced at the request of some seventy United States judges. It received the hearty support of the Department of Justice, and was recommended by four successive Attorneys General—Knox, Moody, Bonaparte and Wickersham. It was passed by the Senate three times, and stood on the House calendar of the last Congress with the unanimous approval of the Judiciary Committee. On a suggestion made from the floor of the House when the Judicial Code came up for consideration, the provision for the *Federal Reporter* purchase was incorporated in the Code, where it properly belonged. This measure is (to quote the language of Judge Locke, of Key West) "not alone to aid the judges, but is in the interest of economy and more speedy termination of all classes of litigation." It is an interesting fact that the Government has heretofore wholly failed to make provision for supplying these Federal courts with the reports of their own decisions, and has depended for over thirty years upon the courtesy of the publishers in supplying the judges with complimentary copies of the reports of their opinions.—*West Publishing Company's "Docket."*

## RECENTLY PATENTED INVENTIONS.

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

### Pertaining to Apparel.

GARMENT HANGER.—F. P. TRAVERSI, New York, N. Y. The more particular purpose here is to provide a hanger having compartments for holding material for destroying or driving away moths and other vermin. The invention contemplates the addition of a longitudinal member provided with graduations in order to adapt the device for use upon garments of various kinds and sizes.

### Electrical Devices.

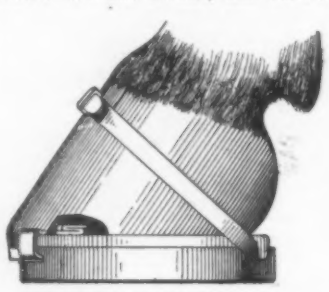
MOUTHPIECE.—LOUIS STEINBERGER, Brooklyn, N. Y. The particular purpose of the inventor is to improve the acoustical action of the mouthpiece, especially as applied for use in connection with telephone transmitters and the like, and to provide a form of construction that effectually prevents chipping or breaking away of portions of the mouthpiece, the construction thus combining great mechanical efficiency and strength.

### Of Interest to Farmers.

HAY RACK.—J. HAYDEN, Le Sueur, Minn. This rack is adapted to be removably associated with vehicle frames and like structures, and has reference more particularly to the combination with a frame having a socket, or a rack adapted to be mounted upon the frame, and having a securing member adapted to enter the socket and serving to hold the securing member in place.

### Of General Interest.

AUXILIARY HORSESHOE.—P. W. ZELLER, 34 Mathews Street, Buffalo, N. Y. In the ordinary horseshoe, when it becomes worn, it is necessary to take the horse to the blacksmith and waste a considerable amount of time in order to replace the worn shoes with new ones. An object in this invention, therefore, is to provide a detachable auxiliary shoe which can



AUXILIARY HORSESHOE.

be attached and detached in a remarkably short space of time, and which still may be securely fastened to the hoof, so that it cannot be accidentally disengaged, and so that the horse cannot kick it off. The invention illustrated herewith provides a shoe with a resilient body portion having sharpened metallic projections embedded in the body portion, adapted to engage the ground to prevent slipping.

LINEMAN'S PRUNING IMPLEMENT.—C. M. TAYLOR, Paris, Ky. This invention pertains to pruning implements that are used in trimming trees and has for its object to provide an implement especially adapted to the use of lineman in keeping telegraph, telephone, electric light and trolley wires free from interference by limbs, etc., as well as in trees generally, having novel features of construction that are remarkably efficient and that afford means for assembling with a single upward thrust several small limbs that are to be removed and cut aside limbs smoothly and with little effort.

PHOTOGRAPHIC PRINTING APPARATUS.—D. W. GRAY, Little Falls, N. Y. This apparatus is adapted for use either with natural or artificial light, and for adjustment at different inclinations, in order to facilitate admission of light from either source. The inventor provides a printing frame proper and a ruby-glass holder, with means for operatively connecting them so that when one closes the opening through which light is received, the other is raised and uncovers the same.

COUNTER.—I. C. SNOWDEN, Richmond, Mo. The object of this improvement is to provide a counter especially designed for grocery stores, wherein a separate bin or receptacle is provided for each class of bulk goods, and wherein each bin is provided with a display compartment, showing the nature and quality of the goods in the particular bin.

CONCENTRATOR AND AMALGAMATOR.—W. M. NESBIT and E. PIKE, Eureka, Utah. By means of this invention small particles of precious metals, for example, "flour gold" and "flour quicksilver," can be easily and expeditiously recovered from the pulp, tailings, sand, or other material, as well as metal such as coarse or float gold. It can be used as a concentrator for different materials, and is adapted for the use of electricity as an aid in recovery of metals.

PEN NIB.—MARVIN E. TURNER, Cuero, Texas. The invention relates to pens, more particularly to supplementary-reservoir pen nibs, and the aim is to provide a non-leakable and easily operated pen nib for use in penmanship. In the pen shown in the engraving the operation of the ink flowing from the nib

PEN NIB.

point is governed entirely by the principles of capillary attraction or cohesion; and as the ink contained in the pen does not appear on the outside of the same except immediately as it is used, a pen is provided having a uniform and consistent flow of ink.

### Hardware and Tools.

TWIST DRILL.—E. B. MATHER, Rochester, N. Y. This invention provides a drill wherein the cutting area is reduced; provides a drill wherein is formed a central guide for the operation of the tool; and provides a construction for a drill having a throated central opening for the passage of guiding core formed in the metal by the drilling operation.

### Machines and Mechanical Devices.

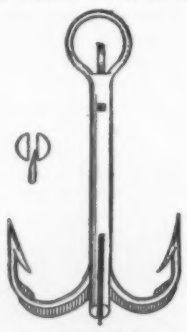
PROPELLER.—F. C. GORDON, Asotin, Wash. This invention relates to propellers having reversible blades so that the shaft, while turning continuously in one direction may be made to drive the vessel ahead or astern as desired. The invention is an improvement over a similar device disclosed in a prior patent granted to Mr. Gordon.

### Railways and Their Accessories.

CAR FENDER.—J. P. GERAGHTY and GEORGE W. NAYLOR, Jersey City, N. J. The invention provides a fender more especially designed for use on cars of street railways and the like, and arranged to normally stand a distance above the track, so as not to interfere with switches and the like or become injured in contact with the track, and to automatically move into a lowermost position when striking a person or other object in its path and safely receive and retain the object, thus preventing injury to the same. Means provide for protecting the fender in the case of collision.

### Pertaining to Recreation.

FISH HOOK.—JOSEPH J. MUELLER, Gold Rock, Ontario, Canada. This invention refers more particularly to the combination with a hook having a barb, of a guard movable into and out of juxtaposition with the barb of the hook to render the same inoperative. The object of the invention shown herewith is to provide a hook which has a barb so that when



FISH HOOK.

forced into the body the barb tends to prevent withdrawal of the hook, and which is provided with a guard normally inoperative, and movable into a position to render the barb inoperative, to permit the hook to be withdrawn, which renders easy and quick the removal of the hook from the mouth, which prevents injury to the hook and unnecessary suffering, and which can be applied to hooks of different types and sizes.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

## NEW BOOKS, ETC.

THE COLLEGE MATHEMATICS NOTEBOOK. Designed and arranged by Robert E. Moritz. New York: Ginn & Co. Biflex binder; 106 pp. Price, 80 cents.

Prof. Moritz, who is head of the Department of Mathematics in the University of Washington, has compiled this notebook for the use of classes in algebra, analytics, and the calculus; it will also prove of value to students in physics, astronomy, chemistry, and engineering. The contents include lists of the more important formulas from algebra, geometry, trigonometry, and analytics; a number of tables; and eight sets of standard graphs. There are a hundred pages of co-ordinate paper suitable either for curve-tracing or for ordinary purposes, the reverse of each sheet having plain record-ruling. The tables, formulas, and graphs are those most commonly used; presented in this convenient form, the student can not fail to acquire a familiarity with them that will stand him in good stead.

THE AMERICAN YEAR BOOK. A Record of Events and Progress. Edited by S. N. D. North, LL.D. New York: D. Appleton & Co., 1911. 8vo.; 867 pp. Price, $3.50 net.

This is the first issue of a proposed series of annual reviews covering progress in every field of human endeavor. The most significant details in politics, government, economical and social questions, art, industries, science, and the humanities, have been collated and concisely expressed, each division coming under the attention of an expert. The undertaking has been thoughtfully planned and the engagement of so distinguished a board of scientists, lawyers, and engineers, to say nothing of the standing of the actual contributors, speaks well for the accuracy, interest, and usefulness of the new venture. While it has been impossible to separate American endeavor and progress from that of the world at large, the selection of material has always been governed by the American view-point, so that the title of the work conveys a true impression of its attitude. From finance, banking, and insurance, to philosophy, psychology, and religion, all the topics likely to touch the thoughtful American are dwelt upon at sufficient length to be informing. New subjects, such as aviation, have not been overlooked or omitted. Art, literature, and music are treated by writers well qualified to handle their themes. An index of nearly two thousand items rounds out the efficiency of the service.

THE PRINCIPLES OF ELECTRIC WAVE TELEGRAPHY AND TELEPHONY. By J. A. Fleming, M.A., D.Sc., F.R.S. New York: Longmans, Green & Co., 1910. 8vo.; 906 pp.; illustrated. Price, $7.50 net.

The science of radiotelegraphy is advancing at so rapid a rate that, in spite of the bulk and the scope of this second edition, the author admits his failure to make it exhaustive. Granting the inevitable incompleteness of any treatise on so new and complex a subject, we must acknowledge this as a definite contribution to the literature of the science. By restricting the historical narration and the description of outworn systems, the author has been able to give the most of his space to modern appliances and methods, and to the important processes and measurements involved. Radiotelegraphy has now reached a stage where further achievement depends very largely upon exact measurements and their accurate application to the problems in hand. For this reason the quantitative aspect of the subject has been given extended consideration and treatment. The final chapter concerns itself with wireless telephony, its problems; the generation and control of oscillations; transmitters and receivers; and the achievements and imperfections of existing systems. The bibliography of wireless telegraphy is given in an appendix.

HANDBOOK OF AMERICAN INDIANS. Edited by Frederick Webb Hodge. Part 2. Washington: Government Printing Office, 1910. 8vo.; 1221 pp.; illustrated.

To the student of ethnology a description of this standard work will be unnecessary. For the benefit of those others who may be interested in the American Indian north of Mexico, we may say that the arrangement of the matter is alphabetical, this second and final part presenting N-Z, inclusive. The list of contributors is an impressive one, and the longer articles are all signed. Tribal divisions, prominent individuals, traditions, superstitions, customs, and handiwork are set forth authoritatively. Such articles as "Stonework," "Sculpture and Carving," "Religion," "Shamans and Priests," and "Sacrifice" are interesting alike to students and to casual readers. A bibliography is included.

INVENTORS AND INVENTIONS. New York: Henry Robinson, 41 West 33rd Street. Price, 25 cents.

This is a thoroughly practical pamphlet, which can be read with profit by every inventor who is not familiar with patent procedure. Good sound advice is given, which comes from a man who evidently knows something of the trials and tribulations as well as the successes of inventors.

LEGAL NOTICES



## INQUIRY COLUMN

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. There is no charge for this service. **In every case it is necessary to give the number of the inquiry.** Where manufacturers do not respond promptly the inquiry **may** be repeated.

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**Inquiry No. 9242.**—Wanted, addresses of makers of bag valves.

**Inquiry No. 9243.**—Wanted, address of maker of Rover's monogram embossers.

**Inquiry No. 9244.**—Wanted, address of manufacturers making rollers, scrapers, and driers suitable for making soap leaves.

**Inquiry No. 9246.**—Wanted, addresses of parties having raw materials or minerals containing potash in any form.

**Inquiry No. 9247.**—Wanted, to buy a Parmelee aerated water.

**Inquiry No. 9248.**—Wanted names and addresses of manufacturers of machinery and appliances for weighing and packing absorbent cotton in rolls.

**Inquiry No. 9249.**—Wanted the address of parties who can ship sunflower seed in quantity.

**Inquiry No. 9250.**—Wanted the names and addresses of manufacturers of electrically-driven gyroscopes for laboratory use and information with regard to same.

**Inquiry No. 9252.**—Wanted, names and addresses of manufacturers of whaling guns and implements.

**Inquiry No. 9253.**—Wanted, addresses of parties having deposits of manganese, graphite, barytes, ochres, or siennas.

## A Painting in Glass on a Canvas of Concrete

(Continued from page 425.)

bright sky or a sheet of sunlit water. The painted surfaces reflect only a small portion of the light they receive, and in order to produce the effect of brightness, it is necessary to tone down and subdue the darker parts of the picture. In this respect the artist who paints with glass upon a canvas of cement has a distinct advantage. The light reflected by the glass is relatively so much greater that the colors of the darker portions may be reproduced in their natural tone.

The beauty of the curtain cannot adequately be shown in the accompanying half-tone reproduction. As various lights are played over the scene the sky changes from a deep blue to a purple tone, while the sides of the mountains are resplendent with colors that are to be found only in the clear dry atmosphere of the west, while the water at the foot of the mountains undergoes remarkable changes from blue to bright green, and then to a deep purple.

The theater in which this curtain is to be placed is being built of white marble. It will cover an area of five acres and will cost over $8,000,000 in gold. A pleasing feature of its design is the use of parabolic curves in place of the plain arch or the triangle of the purely classic.

## The Heavens in May

(Continued from page 431.)

the month, when he rises about 3:45 A. M., and can be seen before sunrise.

Venus is evening star in Taurus and Gemini. She is about 25 deg. north of the equator, and consequently remains in sight till an unusually late hour—about 10 P. M. on the 1st and 10:30 on the 31st. She is bright enough to cast a very conspicuous shadow when her light is admitted through a window to a white wall opposite. Telescopically, she appears like the Moon above three-quarters full, but, as always, shows no definite markings.

Mars is morning star in Aquarius and Pisces, rising about 2 A. M. near the middle of the month. Jupiter is in Libra just past opposition, and is a splendid object all night long.

From 2:24 to 2:28 A. M., and also from 3:06 to 4:13, Jupiter appears to have but one satellite, the fourth. The first satellite is behind the planet, the second in front of it, while, the third is at first behind the planet and later in its shadow. This succession of phenomena will be of great interest to observers who have even small telescopes at their disposal. Saturn is morning star in Aries, too close to the Sun to be seen till the end of the month, when he rises at about 3:30 A. M. On the morning of the 28th he is in conjunction with Mercury at a distance of 1½ deg.

Uranus is in Capricornus, and comes to the meridian about 4:30 A. M. in the middle of the month. Neptune is evening star in Gemini. On the 29th he is in conjunction with Venus, but nearly 3 deg. south of her.

The Moon is in her first quarter at 8 A. M. on the 5th, full at 1 A. M. on the 13th, in her last quarter at 4 A. M. on the 21st, and new at 1 A. M. on the 28th. She is nearest us on the 28th, and remotest on the 15th. In her course around the heavens she passes near Venus on the 1st, Neptune on the 3rd, Jupiter on the 11th, Uranus on the 18th, Mars on the 22nd, and Neptune and Venus again on the 30th.

Princeton University Observatory.

## The Light of the Glow-worm

OF late the French entomologists have given much study to the glow-worm, particularly with reference to the source and nature of its light.

It is found that both male and female are luminous, although in the former the light is much feebler. Even the eggs and larvæ are faintly luminous. The light is produced on the last three segments of the abdomen.

It may perhaps be worth pointing out that the glow-worm is not a worm, but an insect belonging to the great order of beetles, the Coleoptera. The mistaken name arises, no doubt, from the fact that the female is grub-like in form, without either wings or elytra, and so singularly

(Continued on page 437.)

# Notes and Queries

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(12439) H. E. asks: A says that a rifle ball having a velocity of 60 miles per hour, fired from a rifle, on rear platform of a train capable of same speed, in opposite direction of motion of train (presuming the train starts from a given line and capable of attaining the speed of 60 miles per hour instantly at the instant cartridge is fired) will appear to drop to the ground under its original position in rifle before firing. B says it will fly from original position as far as if fired by person standing on the ground. Who is right and why? A. The principle of flight of a rifle ball or any other object thrown from a moving platform is that it will move with a velocity and to a distance equal to the algebraic sum of its several motions. If the rifle is at rest on the earth when it is fired, the ball will have but one motion as referred to the earth's surface, and will go as in the ordinary way. If the gun platform is moving in the opposite direction from that in which the ball is discharged, the ball will seem to move with a velocity equal to the difference of the motion of the gun and the ball. If these two motions are equal and opposite in direction the ball will not seem to have any motion as viewed from the earth at that point. This question comes up every little while, and we answer it in print once in a while for the benefit of those to whom it may be new. It always provokes discussion, but a reference to a text book of physics would settle most of the questions which arise. It is not necessary to suppose a car and a rifle. The tossing of a ball from a moving cart can be just as easily managed, without a high velocity, and the effect noted by a person standing by the side of the road.

(12440) F. S. C. asks: A little after 6 o'clock P. M. on March 2nd and 3rd I observed a somewhat peculiar phenomenon, and commented upon the same with several friends. Although the moon was only thinly crescent, its whole spherical outline was quite visible. I should like very much to see an account which would give a scientific explanation of this phenomenon, which I do not remember ever to have seen before. How is the optical illusion to be explained that the bright crescent side of the moon appeared to bulge slightly in the circumference? At least that was the appearance to my eye. A. The phenomenon to which you call our attention is called "earth shine," and "the old moon in the new moon's arms." It may be seen for a few days after new moon each month. It is caused by the light which is reflected back toward the sun from the earth. This light strikes the moon, and illuminates the dark part of the moon to such a degree that it is faintly visible. When the moon gets older, the amount of light sent to the earth is so great that the dark part of the moon is not visible. You will find the matter explained in the astronomies (see Todd's "New Astronomy," page 225) which we send for $1.50 postpaid. The apparent distorsion of the edge of the moon would seem to be due to a defect in the eye of the observer; perhaps the eye is approaching age, or is somewhat astigmatic. We cannot tell from the mere statement of the fact. It is the case with the writer now, but was not so formerly, before he found it necessary to wear glasses. A youthful eye or a normal eye does not see it in that way.

(12441) R. A. C. asks: If there be a stationary engine in any plant standing still for several hours, and it be a 150 horse-power high-speed, 300 revolutions per minute, and the exhaust pipe 6 inches in diameter extending down from the cylinder beneath the floor, then turning with an L, extending 10 feet, then rising with an L 2 feet, then turning with another L into a pressure heater, then straight out through the heater to the open with a rise of 20 feet. Now if the drain in the exhaust pipe becomes stopped up, and the exhaust pipe beneath the floor becomes filled with water at a temperature of about 35 deg. F., on starting the engine what would be the result? A. Nine chances out of ten, the engine would start up, labor heavily, until the water was blown out of the exhaust pipe, and then run as usual. There is a chance that the cold water might condense the steam in the cylinder suddenly, rush back into the cylinder, and wreck the engine; and no engineer is justified in starting an engine with such an exhaust pipe as you describe until he has drained out the water, even though he might have done so many times without accident.

(12442) J. V. D. asks: What are the main things or parts necessary to make a wireless station capable of sending messages two hundred miles or over? How could a 110-volt circuit be used for wireless transmission? A. The principal apparatus for a transmitting station of the wireless telegraph is a generator of current, a transformer, condenser, oscillator, helix, key, switches, aerial, wire, and lightning arrester. For the receiving set are required, in addition to the above, an oscillation detector, tuning coil, receiving condenser, and head telephones. A 110-volt circuit can be used as easily as any other for a source of current. It is only necessary to have your apparatus adapted to take this voltage. For 200 miles you will require a 2-kilowatt outfit to meet all conditions of the atmosphere. You will find a 100-mile outfit described in our SUPPLEMENTS Nos. 1605, 1622, 1623, 1624, 1625, and a 1,000-mile receiving outfit in Nos. 1814, 1815, 1816. We will send these papers for ten cents each.

(12443) B. H. writes: In the article on cometary orbits appearing in the SCIENTIFIC AMERICAN of February 25th, 1911, appears the expression "the tremendous force of gravitation." Although the writer may not have intended that this should be taken literally, it is nevertheless a fact that most people think of gravitation as being a very strong force. This is certainly not the case as is shown by the following illustration from Comstock's "Text Book of Astronomy." "Elaborate experiments which have been made to determine the amount of this force show that it is surprisingly small, for in the case of two bullets whose mass of one gramme each is supposed to be concentrated into an indefinitely small space, gravity would have to operate between them continuously for more than forty minutes in order to pull them together, although they were separated by only one centimeter to start with, and nothing save their own inertia opposed their movements." From this it may readily be seen that compared with electro-magnetic or with most chemical forces, gravitation dwindles into insignificance. A. From your point of view, it is entirely unnecessary to dispute whether gravitation is a "tremendous" or a "surprisingly small" force. We have seen an avalanche of ice, thousands of tons, fall 8,000 feet, and we have been over many a trail of rock or snow avalanches in our Great West, where trees and earth were swept away clean for long distances and over large spaces. We said tremendous force, and do not now retract the statement. Nor does this seem to disallow any part of what Mr. Comstock says about the minute effect of gravitation between two small balls. The mighty earth can make the bullet or a boulder move with enormous speed and mighty force. The force between two may be as small as between two bullets, and produce as slow and slight a displacement. It is not fair to compare a magnetic force of one degree with a gravitational force of another degree. No electro-magnet in existence could lift the stones of an avalanche back again to the place from which they started. An electro-magnet of a certain power can exactly balance the same amount of gravitational force. There seems to be no reason for these two kinds of force quarreling with each other. It all depends on how one looks at the matter.

(12444) S. L. asks: I have read with much interest an article on Solar Radiation in your issue of January 21st. This has always been an interesting subject to me, and especially the consideration of how the sun heat might be utilized in the heating of the home. Can you give me an idea if anything has yet been made, and is now on the market, that can be bought at a reasonable price that would furnish heat for the time the sun shines, and that could be used as a supplement to the ordinary domestic heating plant. If known to you, kindly give me the names of any makers who are making along this line, so I may be able to communicate with them. A. Articles discussing the power to be obtained from the heat of the sun appeared both in the SCIENTIFIC AMERICAN and the SUPPLEMENT of January 21st and February 4th, 1911. These give you a good idea of what is at present known on the subject. There is an effective steam pump run by the sun's heat at the ostrich farm, Pasadena, California, which has been operating for a number of years. In France also machines of this sort have been made, but we do not know any firm at present engaged in such manufacture. The letter from Mr. Shuman in the SUPPLEMENT for February 4th contains the statement that such machinery will be made before long in this country.

(12445) F. A. asks: How much lighter than air is natural gas at sea level? How much lighter at ten thousand feet altitude? If it was subjected to a pressure of say 50 pounds per inch, what would be the effect? Would its raising force be increased in proportion to the pressure it would be subjected to? A. The principal constitutent of natural gas is marsh gas, the specific gravity of which is 0.599 at normal pressure and the freezing point. At a place where the barometer stood at 29 inches, the gas would be 29/30 as dense. This is at 910 feet above sea level when the barometer is at 30 inches at sea level. If it were put under a pressure of 50 pounds, the density would be 3 1/3 times as great, or 1.8 as dense as air. Its lifting power would be increased in the same proportion as the pressure was increased.

unlike a typical beetle. The male, however, possesses both and flies swiftly. Luminosity among insects indeed is chiefly found in the beetle order. The Mexican fireflies (Pyrophorus), for example, are beetles. Some of them give out sufficient light to read by. Waterton sometimes used them in this way to write up his diary when wandering in the South American forests.

In adult life the glow-worm is a vegetarian, feeding on tender leaves of plants, but while a grub it is carnivorous, feeding on snails and slugs. The light of the glow-worm and fireflies has been called phosphorescent and attributed to phosphorus. Jousset de Bellesme has stated his conviction that it is phosphoretted hydrogen gas stored up in the cellular tissues and in communication with the nervous and respiratory systems.

Fabre, however, finds that phosphorus does not enter into the composition of the luminous substance of the glow-worm. Under the microscope it is seen to be a sort of white plaster covering the epidermis and full of branching tubes. These, according to the authority mentioned, supply the plaster with oxygen and so render it luminous. Thus the light is caused by the oxidation of something the nature of which the naturalist has not yet been able to determine.

According to Fabre's observation the light is caused by the supply of oxygen that is under the control of the animal's breathing apparatus. Thus the glow-worm can start, increase or extinguish the light at will. It has often, indeed, been observed to diminish or extinguish its light when approached. Gilbert White has an interesting note on this point. Observing two that had been brought into a garden, he found that they put out their lamps between 11 and 12 and shone no more for the rest of the night. It would appear, then, that whatever the nature of the luminous substance, this is active only when supplied with oxygen by the animal.

However produced, it is said that the light of the firefly and glow-worm is the most economical known. Economical, that is, in the sense that the greater part of the energy expended in producing it really appears as light. In the very best artificial system of lighting yet invented only a small percentage of the energy expended on its production is turned into light, the rest appearing as heat and other invisible vibrations.

### Plants That Like Cold

CLIMATE affects the inhabitants of the sea just as it does those of the land. As Arctic land-plants cannot flourish at the equator, so in the Arctic and Antarctic oceans marine plants are found that are unable to survive in warm water.

Among the most remarkable of these cold-water plants are the *laminariaceæ*, a kind of sea-weed, which sometimes attain a gigantic size, exceeding in length the longest climbing-plants of the tropical forests, and developing huge stems like the trunks of trees.

Investigation has shown that these plants flourish in the coldest waters of the polar seas, and that they never advance farther from their frigid homes than to the limits of "summer temperature" in the ocean. The genial warmth destroys them, just as a polar blast shrivels the flowers of a tropical garden.

### Strange Ocean Chasms

ALONG our Pacific coast there is generally found a "platform," about ten miles broad, sloping away from the shore until it reaches a depth of one hundred fathoms, then dropping rapidly.

The edge of this platform, it is averred, is broken by twenty-seven submerged valleys, some of which are in line with rivers entering the sea. But at least two of them have mountains as the shore opposite their heads. One of these, called King Peak Chasm, has been the scene of a shipwreck under peculiar circumstances. The ship ran on the rocky coast and was lost in foul weather, when the rocks could not be seen. It is believed that the doomed vessel unknowingly followed the line of the submerged valley, or chasm, and her captain, finding that his soundings showed no bottom, believed he was at a safe distance from the coast.

### Aeronautics

**Italian Aviator Killed.**—While attempting a flight over the Seine at Puteaux, near Paris, on March 28th, M. Cei, an Italian pilot of a Blériot monoplane, lost control of his machine and was dashed to the ground from a height of 2,000 feet. He was terribly injured and died a few hours later.

**Another Attempt to Fly from Nice to Corsica.**—The first stage of the proposed race from France to Algiers, i. e., Nice to Corsica, was attempted on April 21st by the Marquis Villeneuve on his Blériot monoplane. He started at 9 A. M. on this 125-mile flight, but turned back on account of fog. The death of Cecil Grace and the marvelous escape of Lieut. Bague when attempting the same flight some weeks ago would make it seem that the Marquis used excellent judgment in awaiting better weather conditions.

**First Flight of New Zeppelin Airship.**—The first of the three new Zeppelins, which are to be used for passenger carrying this summer in Germany, made its initial flight at Friedrichshafen on the 30th ultimo. The new airship is somewhat larger than the "Deutschland," which, it will be remembered, was demolished by falling into the Teutoborg forest last June. A new metal is employed in place of aluminium for the framework of the new dirigible, and it is claimed that a considerable weight will be saved besides the obtaining of a stiffer frame.

**Untimely End of a Parseval Airship Flight.**—At 4:30 A. M. on Friday of last week the new Parseval airship left Charlottenburg, near Berlin, with 10 passengers who hoped to be landed at Amsterdam, Holland, in due course. Near Hanover, after 140 miles of the 200-mile journey had been traversed, the airship ran foul of a tree. She finally broke away from this impromptu mooring and came to earth in some bog land nearby. The passengers escaped unhurt, while the airship envelope was deflated and the entire craft was returned to Berlin by rail. When contrasted with the numerous successful aeroplane flights across country with passengers it would seem that a surer way to have transported the 10 passengers would have been to have used five aeroplanes, the cost of which would have been insignificant compared to that of the dirigible.

**Testing the Motors of Brucker's Airship.**—The shop tests of the motors to be installed in Brucker's trans-Atlantic airship were recently made. The engines have not come up to expectations, one of them being rejected for good. Since it is intended to prevent, at any price, a repetition of the Wellman experiences and to start only if the motors are in fit condition, Brucker has decided to postpone his trip until next November. If necessary, several months will be devoted to experimenting. The gas bag seems to have been very satisfactorily and substantially made. November has been selected for the date of the start because the hurricane season of the tropics lasts from June until November. The delay is perhaps not unwelcome, since it offers the advantage of testing the airship this summer and of training the crew.

**Military Aviation in France.**—In France the military developments grow apace. Already the army has over fifty machines of the approved patterns, and not many fewer than 100 skilled military air-pilots. Moreover the Ministry of War has offered a prize for competition among aeroplane constructors this year. The Army Geographical Department has drawn up the first of a series of maps for the use of flying men. Printed boldly in six colors, it corresponds with what an airman can see of the earth from a height of 600 feet. The roads are white, while woods and forests are splashes of green. The ups and downs of the country are shown by means of shading light for a gentle rise, heavy for a high hill. Towns and villages stand out clearly in red. Windmills, church towers, factory chimneys, telegraph wires, even tall isolated trees are indicated. Spots where it is dangerous to land because of uneven ground, hop-poles, vineyards and orchards are marked with red crosses for the airman to avoid. It is proposed to continue the work and to map out in this way the whole of France.

## Electricity

**Electric Flat Irons Sold Last Year.**—It is estimated that no less than 250,000 electric flatirons were sold in the United States and Canada last year, says the *Electrical World*. There are more than 10,000,000 homes within central-station territory, of which fewer than 2,000,000 have electric service; consequently the estimated sales last year approximate one iron to every eight homes. Although the electric iron was on the market almost fifteen years ago, its general use dates back only a few years. Other electric appliances have a similar history of long neglect, followed by rapid introduction.

**Light as a Barrier to Eels.**—Some time ago the Danish government began, under the direction of its biological station at Copenhagen, an interesting effort to aid the fishermen of the Baltic by preventing the migration of eels from that sea into the ocean. The means employed is a "barrier of light," formed by placing fifty electric lamps along a submerged cable between the island of Fano and the coast of Funen. The effectiveness of such a barrier depends upon the fact that the eels migrate only during the dark hours. Accordingly, as soon as darkness begins, in the season of migration, the lamps are illuminated, and thus a wall of light is interposed from which the eels recoil. A similar principle is said to have been employed from time immemorial by fishermen on certain parts of the coast of Italy.

**Wireless Telegraphy on Ships.**—The Department of Commerce and Labor is now calling the attention of collectors of customs in our various ports to the Wireless Ship Act of June 24, 1910, which reads as follows: "Be it enacted by the Senate and House of Representatives of the United States of America, in Congress assembled, that from and after the first day of July, nineteen hundred and eleven, it shall be unlawful for any ocean-going steamer of the United States, or of any foreign country, carrying passengers and carrying fifty or more persons, including passengers and crew, to leave or attempt to leave any port of the United States unless such steamer shall be equipped with an efficient apparatus for radio-communication, in good working order, in charge of a person skilled in the use of such apparatus, which apparatus shall be capable of transmitting and receiving messages over a distance of at least one hundred miles, night or day; provided, that the provisions of this act shall not apply to steamers plying only between ports less than two hundred miles apart."

**A New Use for Bakelite.**—It will probably be a long time before the many uses for which Dr. Baekeland's phenol formaldehyde compound is adapted are exhausted. The latest application to which this product has been put is the construction of the dielectric and insulators of the so-called electric "influence machine." These parts have hitherto been made chiefly of glass or hard rubber, but the former has the disadvantage of being fragile, while the latter soon suffers changes under the electric and chemical influences to which it is exposed, and becomes unfit for use. It has been proposed to use celluloid plates, as these are found to be very effective. Unfortunately they lack rigidity and are dangerous owing to their inflammability. It is therefore a very material gain to find that bakelite is not only itself eminently adapted for this use, but can moreover be used to impregnate other substances, such as paper or pasteboard, thereby converting them into excellent dielectrics. It has been found that a machine made with such material will give an effect almost twice as great as a machine of the same dimensions constructed with glass plates. The material for the disks may either be first subjected to the impregnating process, and then cut into disks, or, which is better, the disks are first cut to shape and then treated in the usual manner, that is to say, steeped in the liquid condensation product technically termed the A substance, whereupon the treated body is baked in the bakelizer until completely converted into the solid B form. Those parts of the machine which require shaping are molded in the manner customary for the treatment of bakelite.

## Engineering

**Loetschberg Tunnel in the Alps Cut Through.**—The 9¼-mile long tunnel through the Alps in the Canton of Oberland, which is being built by French engineers, was cut through on March 31st. The French contractors have been four and a half years upon the work. When the tunnel is in working order, it will have cost about fifteen million dollars.

**Hoosac Tunnel Electrification.**—The electrification of the Hoosac Tunnel, on the New York, New Haven and Hartford Railway, is being pushed forward with energy. The tunnel, 4½ miles long, was built in 1875. Operated at first with coal-burning locomotives, these were later replaced by oil burners, and their place is now to be taken by alternating current motors taking 11,000-volt current from the line.

**The Tallest of Tall Buildings.**—The Singer tower, with its height of 612 feet, and the Metropolitan tower, just 700 feet in height, are to be eclipsed by the Woolworth Building, now under construction at Broadway and Barclay Street, this city, whose finial will be 750 feet above the street level. There will be thirty stories in the main building, above which a tower 85 feet square will rise for another 25 stories.

**Superheat in Locomotives.**—In a recent issue of the *Stevens Indicator*, Prof. Wood states that a small amount of superheat in the high pressure cylinder of a locomotive is of little advantage, but when the pressure drop is large between cylinders, a proportionate gain is made by using considerable superheat in the low-pressure cylinder. He finds that superheating to 100 degrees or more for the low-pressure cylinder has theoretically much to recommend it.

**Lift-bridge of Unusual Type.**—There has just been completed across the Willamette River at Portland, Oregon, a bridge with a drawspan which is the heaviest span of the direct-lift type that has been hitherto built. The drawspan is 245 feet long, and weighs about 885 tons. The total lift is 110 feet, and this provides a clearance of 160 feet at mean low water. The lifting is effected by motors with cable connections through the ends of the span to the tower, and a system of concrete counterweights.

**The Largest Airship.**—The huge airship which is building for the British navy at Vickers' Sons and Maxim, will be the largest airship yet constructed, the overall length being 600 feet. It is of the rigid type, the framework being built of an alloy of aluminium known as duralumin, which has a strength and hardness equal to mild steel. The ship will have two gondolas, in the first of which will be a motor driving two propellers, and in the second a motor driving a single propeller. The engine power and speed have not been yet announced.

**The "Puritan" Experiment.**—Official accounts of the "Puritan" experiment, when 200 pounds of explosive gelatine was detonated against the turret armor and against the belt armor, state that the plate of the turret armor was set back and considerably dished, and many deep cracks, some of which probably extend through the plate, were opened. Also the seams between this and adjoining plates were opened up. The turret was not vitally damaged. The charge on the armor belt buckled the plate, swinging the ends of the plate outward and opening the seams. The lower edge of the plate was buckled outward, starting a bad leak on the longitudinal seam below water.

**Unusual Reinforced Concrete Arch Bridge.**—There has recently been completed near Cincinnati, a bridge with two reinforced concrete arched ribs, which stand above the roadway, and whose end thrust is taken care of by steel members laid in the concrete of the floor and tied in very thoroughly with the steel reinforcement at the ends of the ribs. The floor of the bridge is suspended from the ribs by hangers of reinforced concrete, the lower ends of the steel rods inside the hangers being hooked around the rib reinforcement above and the floor rods below. The effect of the finished bridge is simple and pleasing, though there are theoretical objections to reinforced concrete suspension members.

## Science

**The Japanese Antarctic Expedition.**—While the German, English, and Scotch all have sent, or are on the point of sending, large and well-equipped parties to take part in the general campaign of exploration now under way in the Antarctic, a similar undertaking, on a more modest scale, has been launched in Japan. A party of twenty men, headed by Lieut. Shirase, late of the Japanese army, left Tokyo in the small sealer "Kinan-maru" ("Exploring the South") November 29th, 1910. The party hopes to find a suitable landing place along King Edward VII. Land, and to start thence on a sledge journey to the South Pole. The attainment of the Pole appears, in fact, to be the chief or only object of the expedition. The funds for this expedition were raised by popular subscription, and amount to only $50,000.

**Birthplaces of Meteorites.**—From time to time there is more or less speculation as to the origin of the meteoric stones and irons that occasionally fall from the sky. The density of these bodies and the great size of some of them are held to constitute arguments in favor of the view that they must have been ejected from some massive body in space, such as the sun or a star. With reference to the peculiar meteorites that fell some years ago at Brenham, Kansas, it may be inferred from their composition, one authority has suggested, from what part of the heavenly body that ejected them they came. The heavy metallic meteorites called siderites may plausibly be supposed to have come from the deeper parts of a star; the light, stony ones, called aerolites, from the superficial layers; and the rare "pallasites," like the Brenham meteorites, which are intermediate in composition, from the transitional zone between the outer crust and the dense interior nucleus.

**Measuring with Balloons.**—Some time ago there was employed a unique method of measuring the height of certain of the great dome-shaped chambers in the Mammoth Cave. The investigator called to his assistance the toy balloon, and after some preliminary experiments, had his balloons made of a special pattern, with thinner and more elastic rubber than that usually employed. Then, with five balloons tied in a cluster, and each inflated with hydrogen to a diameter of ten inches, he began his attempts at measurement in the cave. An acetylene lamp furnished illumination in the great chambers sufficient to reveal the balloons when they touched the ceiling. The measuring tape was a light silk thread. The rotunda was found to be just forty feet high, and the mammoth dome one hundred and nineteen feet and six inches. But in the vast temple called Gorin's Dome wandering air currents rendered the balloons unmanageable when about two-thirds of the way to the ceiling.

**Views Illustrating Terrestrial Relief.**—According to the *Scottish Geographical Magazine* the plan proposed at the Ninth International Geographic Congress to prepare an atlas of photographic views illustrating the various forms of erosion, has been enlarged. The committee charged with this undertaking, viz., Professors Emile Chaix, J. Brunhes, and E. de Martonne, decided to lay before the next congress, which assembles in Rome this year, plans for an atlas of some 500 to 600 plates covering terrestrial relief in general. Each plate will be accompanied by a sheet of descriptive letter press, containing a brief description of the plate, a topographic map showing the exact point at which the view was taken, and also a section or a block diagram like those employed by Prof. Davis and others. The plates will be issued in sets, and will be classified either systematically or according to regions. It is hoped to publish first, two sets including about twenty plates, dealing with (1) forms directly influenced by tectonic conditions, faults, folding, etc., and (2) forms affected by glaciation. The members of the committee solicit photographs bearing upon these subjects, and especially communications from those who would be willing to subscribe to a first issue of one hundred plates, or to several batches of one hundred. It is expected that a set of one hundred plates will be sold at 50 francs.